



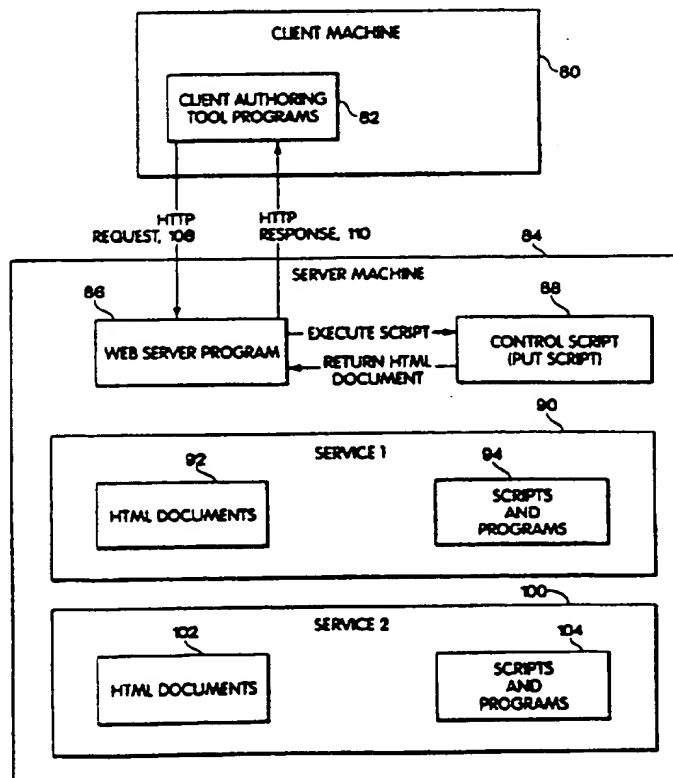
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(54) Title: COMPUTER SYSTEM AND COMPUTER-IMPLEMENTED PROCESS FOR REMOTE EDITING OF COMPUTER FILES

(57) Abstract

A client/server computer system for remote editing of document objects stored on the server includes a client computer connected to a server computer via a communication channel over which messages are sent in a communication protocol. Typically, the client computer has an operating system with the first file name space and the server computer has an operating system with a second file name space and the first file name space does not include names of files which map to names of files in the second file name space. The connection is preferably a TCP/IP connection providing data transport according to TCP/IP. Messages in the HTTP protocol are preferably used. The client computer sends request messages to the server. A request message may indicate a request for either retrieval or storage of a document object, such as an HTML document or script program. The server receives the request messages and processes them to either store a document object or retrieve a document object and return it to the client in a response message. When the server is an HTTP server, the request messages from the client are processed by a single control script. The messages from the client indicate a desired document object and the action to be performed.



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COMPUTER SYSTEM AND COMPUTER-IMPLEMENTED PROCESS FOR REMOTE EDITING OF COMPUTER FILES

Field of the Invention

5 This invention is related to computer editing systems for editing electronic documents. other information and computer programs. More particularly, this invention is related to computer editing systems for developing on-line services in a client-server information system.

Background of the Invention

10 An on-line information system typically includes one computer system (the server) that makes information available so that other computer systems (the clients) can access the information. The server manages access to the information, which can be structured as a set of independent on-line services. The server and client communicate via messages conforming to a communication protocol and sent over a communication channel such as a computer network or
15 through a dial-up connection.

Typical uses for on-line services include document viewing, electronic commerce, directory lookup, on-line classified advertisements, reference services, electronic bulletin boards, document retrieval, electronic publishing, technical support for products, and directories of on-line services, among others. The service may make the information available free of charge, or
20 for a fee.

Information sources managed by the server may include files, databases and applications on the server system or on an external system. The information that the server provides simply may be stored on the server, may be converted from other formats manually or automatically, may be computed on the server in response to a client request, may be derived from data and
25 applications on the server or other machines, or may be derived by any combination of these techniques.

The user of an on-line service uses a program running on the client system to access the information managed by the on-line service. Possible user capabilities include viewing, searching, downloading, printing, and filing the information managed by the server. The user
30 may also price, purchase, rent, or reserve services or goods offered through the on-line service.

For example, an on-line service for catalog shopping might work as follows. The user runs a program on the client system and requests a connection to the catalog shopping service using a service name that either is well known or can be found in a directory. The request is

received by the server, and the server returns an introductory page that also asks for an identifier and password. The client program displays this page, the user fills in an identifier and password that were assigned by the service in a previous visit, and the user's information is sent to the server. The server verifies the identifier and password against an authorization database, and returns a menu page that is then presented to the user. Each time the user selects a menu item, the selection is sent to the server and the server responds with the appropriate new page of information, possibly including item descriptions or prices that are retrieved from a catalog database. By selecting a series of menu items the user navigates to the desired item in the catalog, and requests that the item be ordered. The server receives the order request, and returns a form where the user fills in some information about shipping and billing. The user response is returned to the server, and the server enters the order information into an order database.

On-line services are available on the World Wide Web (WWW), operating over the global Internet in which a large number of computers, or sites, are interconnected. The WWW is a "web" of interconnected document objects that are located on various sites on the Internet. The WWW is also described in "The World-Wide Web," by T. Berners-Lee, R. Cailliau, A. Luotonen, H. F. Nielsen, and A. Secret, Communications of the ACM, 37 (8), pp. 76-82, August 1994, and in "World Wide Web: The Information Universe," by Berners-Lee, T., et al., in Electronic Networking: Research Applications and Policy, Vol. 1, No. 2, Meckler, Westport, Conn., Spring 1992. Among the types of document objects on the WWW are documents and scripts. Documents that are published on the WWW are written in the Hypertext Markup Language (HTML), such as described in Hypertext Markup Language Specification - 2.0, by T. Berners-Lee and D. Connolly, Internet Draft Document, October 14, 1994, and in "World Wide Web & HTML," by Douglas C. McArthur, in Dr. Dobbs Journal, December 1994, pp. 18-20, 22, 24, 26 and 86. HTML documents stored as such are generally static, that is, the contents do not change over time unless the service developer modifies the document. Scripts are programs that can generate HTML documents when executed.

HTML is a language used for writing hypertext documents. The formal definition is that HTML documents are Standard Generalized Markup Language (SGML) documents that conform to a particular Document Type Definition (DTD). An HTML document includes a hierarchical set of markup elements, where most elements have a start tag, followed by content, followed by an end tag. The content is a combination of text and nested markup elements. Tags are enclosed in angle brackets ('<' and '>') and indicate how the document is structured and how to display

the document, as well as destinations and labels for hypertext links. There are tags for markup elements such as titles, headers, text attributes such as bold and italic, lists, paragraph boundaries, links to other documents or other parts of the same document, in-line graphic images, and many other features.

5 For example, here are several lines of HTML:

Some words are **bold**, others are *<I>italic</I>*. Here we start a new paragraph. **<P>**Here's a link to the ****Vermeer Technologies, Inc.**** home page.

10 This sample document is a hypertext document because it contains a "link" to another document, as provided by the "HREF=." The format of this link will be described below. A hypertext document may also have a link to other parts of the same document. Linked documents may generally be located anywhere on the Internet. When a user is viewing the document using a Web browser (described below), the links are displayed as highlighted words or phrases. For example, using a Web browser, the sample document above would be displayed on the user's screen as follows:

Some words are **bold**, others are *italic*. Here we start a new paragraph.

20 Here's a link to **Vermeer Technologies, Inc.** home page.

In the Web browser, a link may be selected, for example by clicking on the highlighted area with a mouse. Selecting a link will cause the associated document to be displayed. Thus, clicking on the highlighted text "Vermeer Technologies, Inc." would display that home page.

25 Another kind of document object on the WWW is a script. A script is an executable program, or a set of commands stored in a file, that can be run by a Web server (described below) to produce an HTML document that is then returned to the Web browser. Typical script actions include library routines or other applications to get information from a file or a database, or initiating a request to get information from another machine, or retrieving a document corresponding to a selected hypertext link. A script is run on the Web server when, for example, 30 the end user selects a particular hypertext link in the Web browser, or submits an HTML form request. Scripts are usually written by a service developer in an interpreted language such as

Basic or Tool Control Language (Tcl) or one of the Unix operating system shell languages, but they also may be written in programming languages such as the "C" programming language and then compiled into an executable program. Programming in Tcl is described in more detail in Tcl and the Tk Toolkit by John K. Ousterhout. Addison-Wesley, Reading, MA, USA, 1994.

5 Each document object in the WWW has an identifier called a Uniform Resource Identifier (URI). These identifiers are described in more detail in Universal Resource Identifiers for the World Wide Web, T. Berners-Lee, submitted as an Internet Request for Comments (RFC) as yet unnumbered. A URI allows any object on the Internet to be referred to by name or address, such as in a link in an HTML document as shown above. There are two types of URIs:

10 a Universal Resource Name (URN) and a Uniform Resource Locator (URL). A URN references an object by name within a given name space. The Internet community has not yet defined the syntax of URNs. A URL references an object by defining an access algorithm using network protocols. An example URL is "http://www.vermeer.com" A URL has the syntax "scheme://host:port/path?search" where "scheme" identifies the access protocol (such as HTTP,

15 FTP or GOPHER):

"host" is the Internet domain name of the machine that supports the protocol:

"port" is the transfer control protocol (TCP) port number of the appropriate server (if different from the default):

"path" is a scheme specific identification of the object: and

20 "search" contains optional parameters for querying the content of the object.

An Internet site that wishes to make documents available to network users is called a "Web site" and must run a "Web server" program to provide access to the documents. A Web server program is a computer program that allows a computer on the network to make documents available to the rest of the WWW. The documents are often hypertext documents in the HTML

25 language, but may be other types of documents as well, as well as images, audio and video information. The information that is managed by the Web server includes hypertext documents that are stored on the server or are dynamically generated by scripts on the Web server. Several Web server software packages exist that provide information on the Web, such as the Conseil Europeen pour la Recherche Nucleaire (CERN, the European Laboratory for Particle Physics)

30 server or the National Center for Supercomputing Applications (NCSA) server. Web servers have been implemented for several different platforms, including the Sun Sparc II workstation running the Unix operating system, and personal computers with the Intel Pentium processor

running the Microsoft MS-DOS operating system and the Microsoft Windows operating environment. The Web server also has a standard interface for running external programs, called the Common Gateway Interface (CGI). A gateway is a program that handles incoming information requests and returns the appropriate document or generates a document dynamically.

- 5 For example, a gateway might receive queries, look up the answer in an SQL database, and translate the response into a page of HTML so that the server can send the result to the client. A gateway program may be written in a language such as "C" or in a scripting language such as Practical Extraction and Report Language (Perl) or Tcl or one of the Unix operating system shell languages. Perl is described in more detail in Programming Perl, by Larry Wall and Randal L. Schwartz, O'Reilly & Associates, Inc., Sebastopol, CA, USA, 1992. The CGI standard specifies
- 10 how the script or application receives input and parameters, and specifies how any output should be formatted and returned to the server.

- Generally speaking, for security reasons, a Web server machine may limit access to files. For all access to files on the Web server, the Web server program running on the server machine
- 15 may provide an extra layer of security above and beyond the normal file system and login security procedures of the operating system on the server machine. The Web server program may add further security rules such as: 1) optionally requiring user name and password, completely independent of the normal user name and passwords that the operating system may have on user accounts, 2) allowing definitions of groups of users for security purposes,
- 20 independent of any user group definitions of the operating system, 3) access control for each document object such that only specified users (with optional passwords) or groups of users are allowed access to the object, or that access is only allowed for clients at specific network addresses, or some combination of these rules, 4) allowing access to the document objects only through a specified subset of the possible HTTP methods, 5) allowing some document objects to
- 25 be marked as HTML documents, others to be marked as executable scripts that will generate HTML documents, and others to be marked as other types of objects such as images. Access to the online service document objects via a network file system would not conform to the security features of the Web server program and would provide a way to access documents outside of the security provided by the Web server. The Web server program also typically maps document
- 30 object names that are known to the client to file names on the server file system. This mapping may be arbitrarily complex, and any author or program that tried to access documents on the Web server directly would need to understand this name mapping.

A user (typically using a machine other than the machine used by the Web server) that wishes to access documents available on the network at a Web site must run a client program called a "Web browser." The browser program allows the user to retrieve and display documents from Web servers. Some of the popular Web browser programs are: the Navigator browser from NetScape Communications, Corp., of Mountain View, California; the Mosaic browser from the National Center for Supercomputing Applications (NCSA); the WinWeb browser, from Microelectronics and Computer Technology Corp. of Austin, Texas; and the InternetWorks browser, from BookLink Technology, of Needham, Mass. Browsers exist for many platforms, including personal computers with the Intel Pentium processor running the Microsoft MS-DOS operating system and the Microsoft Windows environment, and Apple Macintosh personal computers.

The Web server and the Web browser communicate using the Hypertext Transfer Protocol (HTTP) message protocol and the underlying TCP/IP data transport protocol of the Internet. HTTP is described in Hypertext Transfer Protocol - HTTP/1.0, by T. Berners-Lee, R. T. Fielding, H. Frystyk Nielsen, Internet Draft Document, December 19, 1994, and is currently in the standardization process. In HTTP, the Web browser establishes a connection to a Web server and sends an HTTP request message to the server. In response to an HTTP request message, the Web server checks for authorization, performs any requested action and returns an HTTP request message containing an HTML document resulting from the requested action, or an error message. The returned HTML document may simply be a static file stored on the Web server, or it may be created dynamically using a script called in response to the HTTP request message. For instance, to retrieve a static document, a Web browser sends an HTTP request message to the indicated Web server, requesting a document by its URL. The Web server then retrieves the document and returns it in an HTTP response message to the Web browser. If the document has hypertext links, then the user may again select a link to request that a new document be retrieved and displayed. As another example, a user may fill in a form requesting a database search, the Web browser will send an HTTP request message to the Web server including the name of the database to be searched and the search parameters and the URL of the search script. The Web server calls a program or script, passing in the search parameters. The program examines the parameters and attempts to answer the query, perhaps by sending a query to a database interface. When the program receives the results of the query, it constructs an HTML document that is

returned to the Web server, which then sends it to the Web browser in an HTTP response message.

Request messages in HTTP contain a "method name" indicating the type of action to be performed by the server, a URL indicating a target object (either document or script) on the Web server, and other control information. Response messages contain a status line, server information, and possible data content. The Multipurpose Internet Mail Extensions (MIME) are a standardized way for describing the content of messages that are passed over a network. HTTP request and response messages use MIME header lines to indicate the format of the message. MIME is described in more detail in MIME (Multipurpose Internet Mail Extensions): Mechanisms for Specifying and Describing the Format of Internet Message Bodies, Internet RFC 1341, June 1992.

The request methods defined in the current version of the HTTP protocol include GET, HEAD, POST, PUT, DELETE, LINK, and UNLINK. The GET method requests that the server retrieve the object indicated by the given URL and send it back to the client. If the URL refers to a document, then the server responds by sending back the document. If the URL refers to an executable script, then the server executes the script and returns the data produced by the execution of the script. Web browser programs normally use the GET method to send request messages to the Web server to retrieve HTML documents, which the Web browser then displays on the screen at the client computer.

According to the HTTP specification, the PUT method specifies that the object contained in the request should be stored on the server at the location indicated by the given URL. However, the current server implementations do not follow this specification: they simply handle all PUT requests through a single PUT script, which is generally undefined, and must be created by a service author. Web browsers generally do not use the PUT method.

The POST method sends data, usually the user input parameters from an HTML form, to the server. The POST request also contains the URL of a script to be run on the server. The server runs the script, passing the parameters given in the request, and the script generates HTML output to be returned in the response to the client. In order for a client program to send arbitrary data to the Web server using the current HTTP protocol, the client program must use either the PUT method or the POST method, as these are the only two methods that allow such data transfer to the Web server.

Having now described the World Wide Web, a typical on-line service on the WWW will now be described. An on-line service on the World Wide Web includes a Web server program running on a Web server machine, and a set of service files that characterize the on-line services that are stored on the Web server machine. The service files include HTML documents, executable scripts or programs to dynamically produce HTML documents, and other files of service information that can be referenced and updated by the scripts and programs. The actual data and scripts that make up a particular on-line service, including HTML documents and script programs, are generally stored on the server in a separate area for each service. Global information about the service is also stored, including data such as the name of the service, the name of the author, revision history, comments about the service, and authorization information. The end user of the on-line service uses a Web browser program on the client machine to send requests to the on-line service and to receive responses from the on-line service. All access by an end user of the on-line service to the service files is managed and controlled by the Web server program. For example, an on-line service might consist of a corporate home page which is a static document, with a link to a second document that is a form for searching the store catalog. The search form may have a "submit" button that causes a script to be run on the Web server, to generate a list of product descriptions with prices that is then returned to the Web browser as an HTML document. Each of the HTML documents may have a link to a second script that collects and displays the items that have been ordered. The service also has configuration information such as the list of authorized users of the service, and their passwords.

Figure 1 shows the steps in using an on-line service, as seen by the end user of the on-line service on the client machine. The end user starts a Web browser program in step 10, and the program determines the URL of an initial document to display in step 12. The initial document URL may be determined from a configuration file, or may be programmed into the Web browser, or may be entered by the user. The browser then sends an HTTP GET request to the Web server in step 14, giving the URL of the desired document. The browser then waits for a response from the Web server in step 16. The browser tests the response in step 18 to determine if it indicates an error message. If the response message from the Web server indicates an error, for instance if the requested document is not found, then the browser reports the error to the end user in step 22. Otherwise the response message from the Web server contains the requested document, and the Web browser formats and displays the document on the screen in step 20 according to the HTML language conventions. In either case the browser then waits for the user to enter the next

command (step 24). For example, the user may request to view a new document by selecting a hypertext link to a document, by requesting a document from a list of previously visited documents, or by typing in the URL of a document that was obtained by the user through some other means. The browser tests the user command to determine if the user is requesting a new document in step 26. If so, processing continues at step 14 which has already been discussed. If the user is not requesting a new document then the browser tests the command in step 30 to determine if it is a request to exit the program. If so, processing stops. Otherwise the command is a local command that is handled by the browser without sending an HTTP request in step 28. The end user may use local viewing commands such as commands to scroll around in the document, or commands to search for a particular text string in the document. After the browser handles the local command, the browser again waits for the next user command as already discussed, in step 24.

Figure 2 shows the operation of an on-line service on the World Wide Web as seen by the Web server program. When the server is started, it runs continuously, waiting to receive a command over the network connection from a client Web browser program in step 40. The server tests the received command in step 44 to determine if it is a GET request. If it is a GET request, then the server examines the URL contained in the request in step 52 to determine if the URL indicates a static HTML document stored on the server. If the URL does refer to a static document then that document is returned to the Web browser via an HTTP response in step 58. Otherwise the URL indicates a script stored on the server, and the Web server runs the script to produce an HTML document in 56 which is then returned to the Web browser as described before in step 58. If the test of step 44 determines that the command is not a GET request, then the server tests the command in step 48 to determine if it is a POST request. If so, the server retrieves the parameters from the POST request in step 54, which include the URL for the script and the parameters for the script. The server then runs the indicated script in step 56 to generate an HTML document which is then returned to the Web browser as described before in step 58. After an HTML document is returned to the Web browser, processing continues at step 40. If the test of step 48 determines that the command is not a POST request then the server returns an error message to the Web browser in step 50, formatted as an HTML document. The processing continues at step 40 and the server again waits for the next request and the process repeats.

On-line services such as those described above are in high demand. Unfortunately, the task of developing an on-line service is currently one that almost always requires extensive

programming skill and much specialized knowledge. There exists a great need for tools that will simplify the process of building an on-line service so that the process will take less time, be less error prone, and can be done by a nonprogrammer. In some cases, software tools exist to help convert the content data for the service from its native format to the format required by the server, but these tools only address the conversion of static data files.

For example, in order to construct an on-line service for the World Wide Web, the service author performs a combination of the tasks, such as creating a new HTML document for a page of hypertext included in the on-line service, creating a new script included in the on-line service, retrieving and modifying an existing HTML document from the Web server machine, retrieving and modifying an existing script from the Web server machine, and storing an HTML document or script on the Web server machine so that the Web server program will have access to it.

There are several approaches known in the prior art for constructing documents and scripts of an on-line service on the Web, and performing the tasks noted above. The first approach is that the service author runs a text or HTML editor program on the Web server machine to create or modify the on-line service documents and scripts that are stored on the server.

The problem with the first approach is that the service author must be working at the Web server machine, or at least working at a terminal which is directly connected with the server machine. This is not always practical, because the service author may be at a location which is physically remote from the server machine. It also often happens that the server machine requires a high level of security because of the nature of the resources on the server machine that may be shared among a number of users. In this case access to the machine is often limited to the system administrators, and the service author may not have access to the machine for security reasons. For example, the only access to files used by the Web server may be through the Web server alone.

The second approach is that the service author may run a terminal emulation program on a client machine to establish a connection to the server machine over a network connection or a modem line. The terminal emulation program allows the user to run programs on the server machine as though the user were working directly on that machine, and with this arrangement the user runs a text or HTML editor program on the server to create or modify the on-line service documents and scripts as before.

The second approach has the problem that the server machine and client machine must both run additional programs to allow terminal emulation and remote execution of programs over a network. This adds to the complexity on both machines, and also requires that the service author be familiar with a terminal emulation program which typically has a difficult user interface that is not meant for nonexperts. This approach also adds another route from other machines to the server machine, which may be undesirable for security reasons. As with the first approach, the service author may not have access to the server machine for security reasons, or may not have authorization to write files to the machine.

In the third approach, the service author first transfers existing service documents and scripts from the server machine to a client machine either manually or via a network file transfer program. The author then runs a text or HTML editor program on a client machine to create or modify documents on that machine, and then transfers the completed documents back to the server machine either manually or via a network file transfer program, such as the file transfer protocol (ftp) or kermit, a file transfer method used with terminal emulation programs for communication over a modem.

The third approach is cumbersome because of the need for the separate steps of transferring the documents from the server back to the client, and transferring the documents back to the server after the editing is complete. This approach also has the security problems mentioned above for the other approaches.

Each of these three approaches also has the problem that the file names used for documents by a Web server are not always the same as the actual file names of the documents. An author of an on-line service will need to learn the mappings of file names to the URLs used by the Web server.

There is also the World Wide Web computer program, for use with a NeXT computer, that consists of a client browser program that is able to retrieve files from a Web server, and a client HTML editor that can edit the retrieved file. However, this program is not able to save the edited files to the Web server. Instead, this approach is similar to the third approach discussed above in that a file transfer program is still needed to place the edited document back on the Web server. This approach also is not a complete solution for authoring an on-line service for the Web because the types of documents edited in this manner are limited to static HTML documents which are not processed in any way by the server.

Summary of the Invention

To overcome the drawbacks of current methods for creating an on-line service on the World Wide Web, one embodiment of this invention provides a client authoring tool that can both retrieve and store document objects on a Web server using a communication protocol in which messages are sent over a TCP/IP connection between the server and the client. In one embodiment, the communication protocol is HTTP, the same communication protocol used by Web browsers. The architecture of this system is applicable to other communication protocols and client/server on-line services.

One of the difficulties in implementing a client program to save files to a Web server using HTTP is that, although existing Web servers, such as the CERN server and the NCSA server, have support for the HTTP PUT and POST methods, these existing servers still require development and installation of a script on the server to handle either PUT or POST methods.

Another difficulty in implementing a method for remote authoring and editing of an on-line service over the HTTP protocol is that there are two types of component objects for the on-line service that are stored on the Web server. These are static HTML documents, and scripts that dynamically generate HTML documents upon request. If an authoring program would like to retrieve a script from the server, using the HTTP protocol, it cannot simply use the HTTP GET method that is normally used to retrieve documents and access scripts during the operation of an on-line service. The reason is that the HTTP GET method, when used to access a script, causes the script to be executed and returns an HTML document that is generated through execution of the script.

Another difficulty in editing documents for an on-line service in this environment is that a client authoring program generally does not have a file name space that includes the file names of the document objects of the on-line service on the server. Such an overlap in the file name space generally requires use of a network file system. Creation of a network file system including the authors of all on-line services on a server is generally impractical. Such a system is also generally too complex to set up easily and requires too much close interaction among systems than is practical on a large heterogenous public network like the Internet. In many cases, a client authoring system would not have access to the server anyway to enable the set up of a network file system.

To generally overcome these difficulties, one aspect of the invention is a computer-implemented process for remotely editing an electronic document stored on a server computer.

using a client computer, wherein the server computer and the client computer are connected by a communication channel and send messages using a communication protocol. In this process, the client computer sends a request message using the communication protocol over the communication channel to the server requesting a copy of the electronic document. Next, the client receives a response message in the communication protocol from the server and over the communication channel, wherein the response message contains the copy of the electronic document. The client then permits a user to edit the copy of the electronic document at the client computer. To store the electronic document at the server, the client sends a message in the communication protocol including the edited electronic document over the communication channel and to the server, wherein the message includes an indication of a request that the electronic document be stored on the server computer at a particular location. Typically, the server sends a status response message indicating the outcome of the attempt to store the document.

In one embodiment, to overcome these difficulties, the authoring tool uses either PUT or POST HTTP request messages to request retrieval of scripts or documents and to request storage of edited or new documents or scripts. Currently available authoring tools may be readily modified to replace existing "open" and "save" functions to provide this capability. The server may be any standard Web server program such as the CERN server or the NCSA server. Our invention provides a control script which is executed by the server for each incoming PUT or POST HTTP request messages to determine whether a document is to be retrieved or replaced. The authoring tool program uses the HTTP protocol to communicate with a server program running on the server machine. The communication takes the form of the authoring tool sending a request to the server program, the server program executing a control script to perform the indicated action and write the results to an output file, and the server sending a response message back to the authoring client with the output. The output may be either a status message indicating that the action was performed successfully, or contents of a document or script that was retrieved, or an error message indicating why the action could not be performed. The server program may still communicate with browsers at the same time the authoring tool is being used. The server continually listens to incoming messages. If an incoming PUT or POST HTTP request is not from the authoring tool, it is handled in the same manner as other PUT or POST request messages from other client programs such as Web browsers. Otherwise, the server passes the request parameters to the control script. The control script checks the parameters to

ensure that the request is valid, and checks that the user of the authoring tool has the proper authorization. The control script then carries out the request, retrieving or creating, or modifying files of the appropriate on-line service as required.

Another aspect of the invention, in one embodiment, is a computer-implemented process for a client to remotely edit a document object stored on a server, wherein the client and the server send messages using the HTTP protocol over a TCP/IP connection. In this process, the client establishes a TCP/IP connection with the server. Then, the client sends an HTTP request message over the TCP/IP connection to the server, wherein the HTTP request message specifies the document object and an indication that the client requests retrieval of the document object. The server receives the HTTP request message and calls a control script. The control script checks authentication and retrieves a copy of the document object if access is authenticated. The server sends the copy of the document object to the client over the TCP/IP connection in an HTTP response message. The client receives the HTTP response message including the copy of the document object. The TCP/IP connection is terminated and the client permits a user to edit the copy of the document object. To store the edited or new document on the server, the client establishes a TCP/IP connection with the server and sends an HTTP request message to the server, wherein the HTTP request message contains a copy of the edited document and an indication of a location on the server to store the copy of the edited document object and an indication that the client requests storage of the edited document object. The server receives the HTTP request message and calls the control script. The control script stores the copy of the edited document object on the server at the location specified in the HTTP request message. The server sends an HTTP response message acknowledging an attempt at storage of the edited document object. Finally, the TCP/IP connection is terminated.

Another aspect of the present invention is a computer-implemented process for enabling a client computer to store a document object on a server computer. In this process the server receives an HTTP request message from the client computer over a TCP/IP connection, wherein the HTTP request message has content including a copy of the document object and an indication of a location on the server computer to store the copy of the document object and an indication that the client computer requests storage of the document object. The server executes a process using the content of the HTTP request message to store the copy of the document object on the server computer according to the indication of the location included in the HTTP request message.

Another aspect of the invention is a computer system for enabling a client computer to store a document object on a server computer. The server computer includes a mechanism which receives an HTTP request message from the client computer over a TCP/IP connection, wherein the HTTP request message has content including a copy of the document object and an indication of a location on the server computer to store the copy of the document object and an indication that the client computer requests storage of the document object. The server computer also includes a mechanism which executes a process using the content of the HTTP request message to store the copy of the document object on the server computer according to the indication of the location included in the HTTP request message.

Another aspect of the invention is a server computer in a computer system for enabling a client computer to store a document object on the server computer. The server computer includes a computer-readable and writable storage medium and a TCP/IP mechanism, having an input for receiving a request from the client computer to establish a TCP/IP connection with the client computer and which establishes the TCP/IP connection. The server computer also includes an HTTP server having an input for receiving an HTTP request message from the client computer over the TCP/IP connection via the TCP/IP mechanism, wherein the HTTP request message has content including a copy of the document object and an indication of name used by the HTTP server to retrieve the document object as stored on the storage medium and an indication that the client computer requests storage of the document object, and an output for storing the copy of the document object from the HTTP request message on the computer-readable and writable storage medium as a file according to the name included in the HTTP request message.

Another aspect of the invention is a computer-implemented process for enabling a client computer to store a document object on a server computer. In this process, the client computer establishes a TCP/IP connection with the server computer. Then, the client computer sends an HTTP request message to the server computer over the TCP/IP connection, wherein the HTTP request message has content including a copy of the document object and an indication of a location on the server computer to store the copy of the document object and an indication that the client computer requests storage of the document object. The client computer then receives an HTTP response message from the server computer indicating a result of an attempt by the server computer to store the copy of the document object.

Another aspect of the invention is a computer-implemented process for enabling a client computer to store a document object on a server computer. In this process, the server computer receives a request message from the client computer, wherein the request message has content including a copy of the document object, an indication of a location on the server computer, defining an indicated name which is a universal name used by other clients to access the document object on the server computer, and an indication that the document object is to be stored in the indicated location on the server computer. The server computer then converts the indicated name into a file name in a file name space of the server computer and storing the document object as a file on the server computer using the file name in the file name space of the server computer. The server computer then sends a response message to the client computer acknowledging storage of the document object.

Another aspect of the invention is a computer system for enabling a client computer to store a document object on a server computer. The server computer includes a mechanism for receiving a request message from the client computer, wherein the request message has content including a copy of the document object, an indication of a location on the server computer, defining an indicated name which is a universal name to be used by other clients to retrieve the document object, and an indication that the document object is to be stored in the indicated location on the server computer. The server computer also includes a mechanism for converting the indicated name into a file name in a file name space of the server computer and storing the document object as a file on the server computer using the file name in the file name space of the server computer. The server computer also includes a mechanism for sending a response message to the client computer acknowledging storage of the document object.

Another aspect of the invention is a computer system for enabling a client computer to store a document object on a server computer. The server computer includes a computer-readable and writable storage medium and a server program executed on the server computer. The server program, as executed, has an input connected to receive a request message from the client computer, wherein the request message has content including a copy of the document object, an indication of a name to be used by the server program to retrieve the document object which is a universal name used by other clients to retrieve the document object, and an indication that the document object is to be stored on the computer-readable and writable storage medium. The server program as executed also has a first output for providing a file name in a file name space of the server computer converted from the indicated name in the received message and a

command to the server computer to store the document object as a file on the computer-readable and writable storage medium using the file name in the file name space of the server computer. The server program as executed also has a second output connected to the client computer to provide a response message to the client computer acknowledging storage of the document object.

In the aspects of the invention where the server receives a universal name, the universal name may be a URL or equivalent indicator. Such a universal name is different from a file name used by, for example, FTP because in FTP a message contains actual file name on server and maintains current working directory information of the user who has logged into the server.

Additionally, such a universal name is different from a file name such as used by a network file system (NFS). In NFS, a message contains physical file name and may maintain current working directory information. In NFS, the mapping of file names and directories is client-dependent and not client independent. In contrast, using HTTP or other server using universal, or client-independent names, a message uses a URL which contains a protocol://host/path which is passed through a mapping step. Thus, a file is accessible on the server only if it is listed in a mapping table of the server which matches trees of directories to URLs. The URL by itself typically cannot be used without a server to identify the file, unlike file names used in FTP. HTTP also has further rules which allow multiple mappings of subdirectories, unlike file names in NFS. Different security may also be provided on different subdirectories using HTTP. In other words, using HTTP and URLs, a names using a directory x and names using subdirectory x/y may be mapped to different places on server. Additionally, permissions associated with a directory x and subdirectory x/y may be different on the server.

Another aspect of the invention is a computer-implemented process for enabling a client computer to store a document object on a server computer. In this process, a server computer receives a request message from the client computer, wherein the request message has content including a copy of the document object, an indication of an application sending the message, an indication of a location on the server computer, and an indication that the document object is to be stored in the location on the server computer. The server then determines whether the request message is from an authorized source by comparing the indication of the application in the content of the request message with accepted applications. When the request message is from an authorized source, the server stores the document object on the server computer using the location indicated in the request message and sending a response message to the client computer

acknowledging storage of the document object. When the request message is not from an authorized source, the server sends a response message to the client computer without storing the document object on the server computer.

Another aspect of the invention is a computer system for enabling a client computer to store a document object on a server computer. The server computer includes a mechanism for receiving a request message from the client computer, wherein the request message has content including a copy of the document object, an indication of an application sending the message, an indication of a location on the server computer, and an indication that the document object is to be stored in the location on the server computer. Another mechanism determines whether the request message is from an authorized source by comparing the indication of the application in the content of the request message with accepted applications. The server also includes a mechanism, operative when the request message is from an authorized source, for storing the document object on the server computer using the location indicated in the request message and sending a response message to the client computer acknowledging storage of the document object. Another mechanism is operative when the request message is not from an authorized source and sends a response message to the client computer without storing the document object on the server computer.

Another aspect of the invention is a computer system for enabling a client computer to store a document object on a server computer. The server computer includes a computer-readable and writable storage medium and a server program executed by the server computer. The server program, as executed, has an input for receiving a request message from the client computer, wherein the request message has content including a copy of the document object, an indication of an application sending the message, an indication of a location on the server computer, and an indication that the document object is to be stored in the location on the server computer. The server program as executed also includes a comparator having a first input for receiving the indication of the application and a second input for receiving an indication of an authorized source and an output providing an indication of whether the request message is from an authorized source. The server program has a first output which provides a command to the server computer when the request message is from an authorized source to store the document object on the computer readable and writable storage medium as a file using the name indicated in the request message. The server program also has a second output which provides a response message to the client computer acknowledging storage of the document object when the request

message is from an authorized source and, when the request message is not from an authorized source, which provides a response message to the client computer not acknowledging storage of the document object.

Another aspect of the invention is a computer-implemented process for enabling a client computer to edit a document object stored on a server computer. In the process, a first HTTP request message is transmitted from the client computer over a TCP/IP connection to the server computer, wherein the first HTTP request message specifies the document object and an indication that the client computer requests retrieval of the document object from the server computer. A process is executed on the server computer using the first HTTP request message which retrieves a copy of the document object. The copy of the document object is transmitted from the server computer to the client computer over a TCP/IP connection in a first HTTP response message. The document object is then edited on the client computer. A second HTTP request message is transmitted from the client computer over a TCP/IP connection to the server computer, wherein the second HTTP request message contains a copy of the document object and an indication of a location on the server computer to store the copy of the document object and an indication that the client computer requests storage of the document object. A process is executed on the server computer using the second HTTP request message which stores the copy of the document object on the server computer according to the indication of the location included in the second HTTP request message.

Another aspect of the invention is a computer system for editing of document objects, comprising a server computer and a client computer. The client computer includes a mechanism for sending a first HTTP request message over a TCP/IP connection to the server computer, wherein the first HTTP request message specifies the document object and an indication that the client computer requests retrieval of the document object from the server computer. The client computer also includes a mechanism for receiving an HTTP response message from the server including the copy of the requested document object and a mechanism for editing the document object on the client computer. The client computer also includes a mechanism for sending a second HTTP request message over a TCP/IP connection to the server computer, wherein the second HTTP request message contains a copy of the edited document object and an indication of a location on the server computer to store the copy of the document object and an indication that the client computer requests storage of the document object. The server computer includes a mechanism for executing a process on the server computer using the first HTTP request

message which retrieves a copy of the document object. The server computer also includes a mechanism for transmitting the copy of the document object from the server computer to the client computer over a TCP/IP connection in the HTTP response message. The server computer also includes a mechanism for executing a process on the server computer using the second HTTP request message which stores the copy of the document object on the server computer according to the indication of the location included in the second HTTP request message.

Another aspect of the present invention is a computer-implemented process for enabling a client computer to edit a document object on a server computer. The process involves sending a read request message from the client computer to the server computer, wherein the read request message specifies the document object using an indication of a location on the server, defining an indicated name which is a universal name used by other clients to retrieve the document object, and an indication that the client computer requests retrieval of the document object. On the server computer, the indication of the document object is converted to a file name in a file name space of the server computer and retrieving a copy of the document object from the server computer using the file name. The copy of the document object is sent from the server computer to the client computer in a read response message. The copy of the document object is then edited on the client computer. A write request message is sent from the client computer to the server computer, wherein the write request message includes a copy of the document object, a universal name for the document object to be used by other clients to access the document object, and an indication that the document object is to be stored on the server computer to be accessible by the client computer using the universal name in the message. On the server computer the indicated name is converted into a file name in the file name space of the server computer and storing the document object as a file using the file name in the file name space. A write response message is sent to the client computer acknowledging storage of the document object.

Another aspect of the invention is a client application for use on a client computer for editing a document object stored on a remote server computer. The client application has an integrated user interface providing access to simultaneously to three mechanisms. The first mechanism retrieves the document object from the server computer. The first mechanism sends a read request message to the server computer including an indication of the document object using a universal name to be used by other clients to access the document object, and an indication that a copy of the document object is to be sent by the server computer to the client computer, then receives a read response message from the server computer including the copy of

the document object, and then stores the copy of the document object in memory. The second mechanism is for editing the document object stored in the memory. The third mechanism is for storing the edited document object on the server computer. The third mechanism sends a write request message to the server including the copy of the edited document object from the buffer and an indication of a universal name to be used by other clients to access the document object on the server to store the edited document object, then receives an acknowledgment message from the server computer and for communicating the acknowledgment message to a user, and finally allows a user to activate any of the means for retrieving, editing or storing with an integrated user interface.

Another aspect of the invention is a computer-implemented process for enabling a client computer to edit a document object on a server computer. This process involves transmitting a read request message from the client computer to the server computer, wherein the request message includes an indication of the document object, an indication of an application sending the message, and an indication that the document object is to be sent to the client computer. It is then determined, on the server computer, whether the read request message is from an authorized source by comparing the indication of the application in the content of the request message with accepted applications. When the read request message is from an authorized source, a copy of the document object is retrieved on the server computer and a first response message is sent to the client computer including the copy of the document object. When the read request message is not from an authorized source, a response message is sent to the client computer without sending a copy of the document object. The copy of the document object is then edited on the client computer. A write request message is transmitted from the client computer to the server computer, wherein the write request message includes a copy of the document object edited by the client computer, an indication of a location on the server computer, an indication of an application sending the message, and an indication that the document object is to be stored in the location on the server computer. It is then determined, on the server computer, whether the write request message is from an authorized source by comparing the indication of the application in the content of the request message with accepted applications. When the write request message is from an authorized source, the document object is stored on the server computer as a file using the location indicated in the write request message and sending an acceptance response message acknowledging storage of the document object. When the write request message is not from an

authorized source, a denial response message is sent to the client computer without storing the document object on the server computer.

It should be understood that other embodiments of the invention may be derived by those of ordinary skill in this art from the exemplary embodiment described below. Other aspects of the invention include the various combinations of one or more other aspects and particular embodiments of the invention, and the embodiments of these aspects of the invention as client systems, server systems and a combination of client and server systems.

One advantage of this system is that current Web browsers do not need to be changed after installation of a control script at the Web server to permit use of an authoring tool in accordance with this invention. This benefit is obtained in one embodiment by utilizing an HTTP method not used by the Web browser, the PUT method, to handle requests from the authoring tool. With this embodiment, changes to authoring tool systems can be made transparently to users who merely view information or use an on-line service.

One advantage of this system over the prior art approaches is that the on-line service author can use a single client program and interface to retrieve a script or document from an existing on-line service on a server, edit or create a script or document for an on-line service, and save the resulting script or document to the appropriate place within the on-line service area on the server.

Another advantage of this system is that the author of the on-line service can edit the on-line service documents and scripts from any client machine, so long as the client machine can run a Web browser and communicate via HTTP protocol with the Web server that hosts the on-line service. The client machine and server machine may have different types of processors, with different architectures, running different operating systems, in a heterogenous network.

Another advantage of this system is that the authoring tool program communicates with the Web server program using the same type of network connection and the same protocol (HTTP) that is used by a Web browser talking to a Web server. This means that the remote editing facility of the invention will work from any client that can support a Web browser communicating with an on-line service. It also means that remote editing with this invention does not require any additional network connectivity programs other than those needed for a Web browser to communicate with a Web server.

Another advantage of this system is that the authoring tool uses the basic authentication procedures provided by the HTTP protocol and the Web server software. Access to files on the

server machine may be limited to service authors with a validated user name and password. Thus, by using the HTTP protocol that is already used for on-line services on the World Wide Web, a minimal level of security is provided during the authoring process.

Another advantage of this system is that the authoring process can be used for remote retrieval, editing, and storing of at least two of the types of document objects that comprise an on-line service on the WWW: static HTML documents and script programs that generate HTML documents.

Remote editing of on-line service document objects using the method of this invention also has several advantages over the prior art approaches, such as remote editing over a network file system where a client machine can read and write files on a remote server machine. One advantage is that our invention allows access to the online service document objects only through the Web server program, and thus conforms to the additional security rules implemented by the server program. A second advantage is that since our invention uses the existing HTTP protocol mechanism of the Web server machine, the server machine does not have to run additional software or server programs that are required to implement a network file system or shared access to a remote file system from a client machine. This is an advantage because the additional software would add complexity and would add further possibilities for security loopholes. A third advantage is that our invention allows access to the online service document objects only through the Web server program, and thus conforms to the document object name mapping conventions between URLs and actual file names of the Web server program. The advantage of the method of our invention is that neither client programs nor service authors need to understand this file name mapping and only need to use the URLs.

Brief Description of the Drawing

In the drawing,

Figure 1 shows the prior art sequence of activities on the Web browser during operation of an on-line service on the Web:

Figure 2 shows the prior art sequence of activities on the Web server during operation of an on-line service on the Web:

Figure 3 shows an overview of the authoring framework for remote authoring of on-line services:

Figure 4 shows the sequence of steps on the Web browser during remote authoring of an on-line service:

Figure 5 shows the sequence of steps on the Web server during remote authoring of an on-line service: and

Figures 6a and 6b show the messages that the client authoring tool sends to the server.

Detailed Description

The following detailed description of an illustrative embodiment of the invention is made by way of example only. It should be read in conjunction with the drawing, in which similar reference numbers indicate similar structures.

Figure 3 shows an overview of a computer system for remote authoring of on-line services. The system includes a client machine 80 connected to a server machine 84 over a communication channel through which the client sends requests 108 and receives responses 110. The client machine has an authoring tool 82 which makes the requests 108. The server machine 84 has a server program 86 which sends responses 110 to the authoring tool 82. The server program 86 has an associated control script 88 which processes requests 108 and generates the responses 110 to be returned by the server program 86. The control script 88, in response to some requests 108, may be used to access on-line services 90 and 100. These services may be authored using the authoring tool 82 to generate appropriate documents 92 and 102 and programs 94 and 104. Generally speaking, the operating system of the client has a file name space which does not include or map to names of files on the server.

In one embodiment of the invention the client machine 80 is a PC with an Intel 80486 processor with a clock speed of 50 MHz, running the Microsoft Windows 3.1 operating system. The authoring tool 82 may be any of a variety of document editors, such as HTML editors, text editors, script editors and the like. The exact form of the authoring tool and the functionality of the editor are up to the needs and desires of the user. However, such an authoring tool allows the retrieval and storage of a document object on the Web server by generating an HTTP request message as described herein. Existing Web browsers could be modified to provide a storage function and editing capabilities to provide this functionality. Additionally, HTML and other editing tools may also be used in conjunction with this invention if modified to allow for retrieving and storing files on the server by generating appropriate HTTP messages as described below. A large number of HTML editors, such as HoTMetaL, from SoftQuad, Inc., of Toronto.

Ontario, Canada, and other document editors and program editors, such as VisualBasic, may be used to create documents and scripts and the invention is not limited thereby. For example, the client machine 80 may have dial-up connection to an Internet service provider, typically using a 14,400 baud or faster modem, and using the Trumpet 2.0b application for Microsoft Windows that provides the TCP/IP protocol software running over a SLIP connection using a normal telephone line. In this arrangement, the client machine 80 is connected to the Internet and has its own Internet address.

In this embodiment, the server machine 84 is a Gateway 2000 personal computer with an Intel Pentium processor with a clock speed of 60 MHz, running the BSDi Unix operating system. The Web server program 86 is the CERN Hypertext Transfer Protocol Daemon (HTTPD) server, configured for the Unix operating system. The server machine 84 also has a dial-up connection to an Internet service provider, using a 14,400 baud or faster modem, and using the TCP/IP and SLIP software that comes with the BSDi Unix operating system. Generally speaking, the Web server program is the only program providing access to documents, other than the operating system. It may define groups of users, user names, passwords and file names separately from the operating system of the server machine 84. With this configuration the client and server machines can establish a TCP/IP connection and exchange messages over the Internet. It should be understood that this embodiment is merely exemplary. A large variety of computers and operating systems have suitable server and client software for communicating using HTTP over the Internet. The client and server machines may also be connected by a local area network (LAN), wide area network (WAN) or may even be the same machine, but with different processes communicating together over a common communication channel. Although communication is generally provided over a TCP/IP connection, other network communication protocols, including other data transport protocols and message protocols may be used. A variety of message protocols for communicating over TCP/IP connections may be used, such as HTTP, FTP, telnet, etc. However, generally speaking, the server and the client do not share files through the file name spaces of their respective operating systems. That is, the file name space of the client does not include or map to names of files on the server. In other words, no pair of file names in the two file names spaces correspond to the same file. More details about setting up client and server machines connected to the Internet and the World Wide Web are discussed in "Setting up Shop on the Internet," by Jeff Frentzen et al., and related articles in Windows

Sources, February 1995, pp. 42, 64-67, 70, 73-74, 77-80, 106, 108, 111, 113-114, 117-120, 122, 125, 128, 134-136, 138-140 and 143.

Communication between the client authoring tool program on the client machine and the Web server program on the server machine can occur when both machines are connected to their respective Internet service providers. Communication between the server machine and client machine takes the form of the client sending an HTTP request to the server 108, the server processing the request, followed by the server replying with an HTTP response message to the client 110. In order to accomplish this, the client authoring tool program establishes a TCP/IP connection to the server program and sends the HTTP request message over that connection. The server program receives the HTTP request message, performs the indicated processing, and replies with an HTTP response message over the same connection. Finally the two programs terminate the TCP/IP connection.

In this embodiment, when an HTTP PUT request is received by the server program, the server program executes a control script 88 written in the Tcl programming language. A suitable control script is described in more detail below in connection with Figure 5 and is also found in the attached appendix. The attached appendix contains material which is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure containing this appendix, as it appears in the Patent and Trademark Office patent file or records, but otherwise reserves all rights whatsoever.

It should be understood that the server program could just as well be programmed to respond to a POST request, given the current version of the HTTP standard. Other protocols, such as FTP could also be used. Different protocols and different messages could be used for both retrieval and storage. For example, FTP could be used to retrieve and HTTP could be used to store, or vice versa. Generally speaking, in this embodiment of the invention, the same type of message is used to process both retrieval and storage of both documents and scripts. The particular message type is not limiting of this invention. For example, a Web server may allow a user to define custom message types. The control script program handles requests to retrieve or store objects in the service data areas 90 and 100 on the server machine. There are two types of objects stored in each service data area: static documents in the HTML language 92 and 102, and script programs that generate HTML documents 94 and 104.

Figure 4 shows a typical flow of control during one remote authoring session, where the service author uses the client machine to retrieve a document from the Web server, edit that

document on the client machine, and save the document back to the Web server. Figure 4 does not attempt to show editing, error handling, and graphical user interface features that are well known in the prior art for text editors and word processing programs. For instance it does not show that the user may be editing several documents independently within several windows, or that the user may abort an editing session at any time without saving a document, or that the user may retrieve, edit, save in one window and then repeat those steps for a different document in the same window. Furthermore, Figure 4 does not attempt to show the editing commands that the user uses to make changes to the document on the client machine because these are well known in the art.

As shown in Figure 4, the service author first runs the authoring tool program on the client machine in step 120, which provides a graphical user interface for remote editing. The author then asks in step 121 to edit a document or script from a particular on-line service, and identifies the object by specifying a document or script name, the service name, and the address of the Web server where the service is stored, such as by using its URL.

The authoring tool program then sends in step 122 an HTTP PUT request to the Web server where the service is stored. The structure of this PUT request is shown in Figure 6a which is described in more detail below, and includes header fields for authorization, the MIME version number, the request content type, and the content length in bytes. The body of the request includes a method command field that identifies the request as a retrieve request and a URL command field that gives the URL for the document or script object to be retrieved.

When the Web server program receives an HTTP PUT request in step 124, it passes it to the control script 88. The control script examines the parameters of the retrieve request, and writes an output file in step 126 that contains either the requested document or script, or an error message for the service author indicating why the request could not be satisfied. Generally speaking, the Web server program translates the URL into a file name in the file name space used by the operating system of the server machine. Such mappings are usually found in a configuration file for the server. The control script can also be made to perform such translation and maintain its own configuration file of mappings. This can be done so that the server does not have to be reinitialized when mappings change, for example, by the creation of a new service. The detailed operation of the control script is shown in Figure 5, and is explained further below. When the control script has finished execution, the Web server sends the resulting output file to the client authoring tool via an HTTP response in step 128.

The authoring tool then receives the HTTP response, containing the document or script that the author requested, and the authoring tool displays the document or script in a new window in step 130, using an appropriate editor. If the response contains an error message for the service author then it is handled in the normal way that an editor program handles the case when a requested file cannot be found. In step 132 the service author edits the retrieved document using the appropriate editor. At any point during the editing process, the service author may issue a command to save the current version of the document or script being edited, as noted in step 134. The save command causes the authoring tool client program to send a replace request to the server.

The replacement process is similar to the retrieval process described earlier. The authoring tool program sends an HTTP PUT request to the Web server where the service is stored 136. The structure of this PUT request is shown in Figure 6b, and includes header fields for authorization, the MIME version number, the request content type, and the content length in bytes. The body of the request includes a method command field that identifies the request as a replace request, a URL command field giving the URL where the document or script is to be stored, and the contents of the script or document that is to be saved on the server.

As with the retrieve request, when the Web server program receives an HTTP PUT request, the server program in step 138 passes it to the control script 88. The control script examines the parameters of the replace request, and attempts to store the document or script on the server at the location given by the URL (step 140), and writes an output file that either contains a status message indicating that the request was completed, or contains an error message for the service author indicating why the request could not be satisfied (step 142). The detailed operation of the control script is shown in Figure 5, and is explained further below. When the control script has finished execution, the Web server sends the resulting output file to the client authoring tool via an HTTP response in step 144.

When the authoring tool receives the HTTP response, if the response is an error message then the error message is displayed for the service author in step 146. Otherwise the authoring tool informs the user that the document or script was successfully saved on the Web server machine in step 146. In either event, the authoring tool waits for a new command from the service author.

Figures 6a and 6b show the structure of the HTTP request messages that the authoring tool sends to the Web server. In each case the parameter "length" on the "Content-length" line is

replaced by the number of characters in the content part of the message (the part of the message that follows the Content-length line). The HTTP requests include a single request line, followed by header fields in the HTTP header, followed by a blank line, followed by command fields in the HTTP request body, followed by optional data in the HTTP request body. Header fields have a header field name followed by colon (":") and a header field value. Command fields have a command field name followed by a colon (":") and a command field value. The format of the request line and header fields is defined by the HTTP protocol specification, while the format of the HTTP request body, including the command fields, is defined by the method of our invention.

Figure 6a shows the HTTP request message format for a "retrieve" request. The first line 201 is the request line, comprising the "PUT" method name 211, followed by the URL for the object to be retrieved 221, followed by the HTTP protocol version number 231. The second line 202 is the authorization header field, comprising the header field name 212, e.g., "Authorization," followed by the header field value 222, in this case "Basic dmVybWVlcjE250Rm9yZ2V0VGhpcw==." This authorization field may be used to carry passwords for protection purposes by the Web server. For example, the Web server may only allow use of the PUT request message by particular users. Also, the Web server could look to the password when a user attempts to write to a file using the Web server. These and other security devices may be used in connection with this invention. The third line 203 is the MIME version header field, comprising the header field name 213, e.g., "MIME_version," followed by the header field value 223, e.g., "1.0". The fourth line 204 is the content type header field, comprising the header field name 214, e.g., "Content-type," followed by the header field value 224, e.g., "application/x-vermeer." The fifth line 205 is the content length header field, comprising the header field name 215, e.g., "Content-length," followed by the header field value 225 giving the length in bytes of the HTTP request body. The sixth line 206 is the blank line that separates the header fields from the HTTP request body. The seventh line 207 is the method command field, comprising the command field name 217, e.g., "method," followed by the command field value 227, "retrieve." The eighth line 208 is the URL command field, comprising the command field name 218, "url," followed by the command field value 228 giving the URL for the object on the server machine that is to be retrieved.

Figure 6b shows the HTTP request message format for a "replace" request. The first line 301 is the request line, comprising the "PUT" method name 311, followed by the URL 321

giving the location on the server where the document should be saved, followed by the HTTP protocol version number 331. The second line 302 is the authorization header field, comprising the header field name 312, e.g., "Authorization," followed by the header field value 322, e.g., "Basic dmVybWVlcjpbEb250Rm9yZ2V0VGhpcw==." The third line 303 is the MIME version header field, comprising the header field name 313, e.g., "MIME_version," followed by the header field value 323, e.g., "1.0". The fourth line 304 is the content type header field, comprising the header field name 314, e.g., "Content-type," followed by the header field value 324, e.g., "application/xvermeer." The fifth line 305 is the content length header field, comprising the header field name 315, e.g., "Content-length," followed by the header field value 325 giving the length in bytes of the HTTP request body. The sixth line 306 is the blank line that separates the header fields from the HTTP request body. The seventh line 307 is the method command field, comprising the command field name 317, e.g., "method," followed by the command field value 327, e.g., "replace." The eighth line 308 is the content type command field, comprising the command field name 318, e.g., "Content-type," followed by the command field value giving the content type identifier 328. The ninth line 309 is the URL command field, comprising the command field name 319, e.g., "url," followed by the command field value 329 giving the URL for the object on the server machine that is to be replaced.

The operation of the control script 88 as running on the server machine, will now be described in connection with Figure 5. As described above, in this embodiment the Web server program calls the control script when a retrieve or replace request arrives from the authoring tool. The control script processes the retrieve or replace request and writes an output file that the Web server will send back to the client as the response to the retrieve or replace request.

As shown in Figure 5, when the Web server calls the control script, the control script first reads the "Content-type" header field of the HTTP request header to get the document type in step 160. A test is performed to see if the document type given in the header field is "application/x-vermeer" (step 162). If the request is not from the authoring tool, then the control script writes an error message to the output file 164 and the control script terminates. When the document type indicates that the request is from the authoring tool, then the test performed in step 162 yields the answer, "Yes," and the control script reads the command fields from the body of the HTTP request (step 166). A test is then performed in step 168 in order to determine if the command fields are acceptable. This test involves determining whether: (1) there is a "method" command field (2) there is a "URL" command field, and (3) the command fields are syntactically

correct. If the command fields are not correct, then the control script writes an error message to the output file in step 170 and the control script terminates. If the command fields are acceptable, then the test in step 168 yields the answer "Yes" and the control script performs a test to determine if the "method" command field value indicates a retrieve request (step 172). If so, then another test is performed to determine if the file given in the "URL" command field value exists and is readable (step 174). If the result is "Yes" then the control script sets the content type by examining the file name extension in step 176. The control script then writes the HTTP response header containing the content type, and the data content of the indicated file, to the output file in step 178, and the control script terminates. If the test in step 174 yields the answer "No" then the control script writes an error message to the output file in step 180 and the control script terminates.

If the "method" command field does not indicate a "retrieve request" then the test in step 172 yields the answer "No" and a test is performed to see if the command field indicates a "replace" request (step 182). If the "method" command field does not indicate a "replace" request then the test 182 yields the answer "No," the control script writes an error message to the output file in step 194, and the control script terminates. Otherwise, if the "method" command field indicates a "replace" request, then another test is performed in step 184 to determine if the file given in the "URL" command field value may be written by the authoring tool and this user. For example, the file may be written if the file does not currently exist, or if the file exists and the service author has authorization to write the file. Authorization may be determined by the Web server, to see if the user attempting to write to a file has provided a correct password. Authorization may also be determined by the underlying operating system, to see if the Web server has authorization to write to the file specified by the URL. If the result of the test in step 184 is "Yes" then the control script stores the data of the HTTP request body in the file indicated by the "URL" command field value (step 186). The control script then sets the appropriate file permissions on the new file in step 188, writes the status message indicating the result of the command into the output file in step 190, and the control script terminates. If the file cannot be written then the test 184 yields the answer "No," the control script writes an error message to the output file in step 192, and the control script terminates.

An advantage of this system is that the client authoring tool does not need to map the file name space of the server to its own file name space. This arrangement is particularly advantageous in large networks, such as the Internet, where there may be many authors of many

on-line services on many servers. In this environment, the ability to remotely author documents is made easier and eliminates the need for complex file systems like a network file system.

Another advantage of this system is that the ability to store files on the server is made possible in a manner which is transparent to usage by any Web browser. By using a control script to control processing of messages, the server also need not be modified. The server is simply configured to recognize the control script, thus allowing easy installation.

Having now described an embodiment of the invention, it should be understood that the foregoing description is merely illustrative, having been presented by way of example only. Numerous other embodiments and modifications may be made. For example, the invention is not limited to use on the Internet or using the World Wide Web or using the HTTP communication protocol. For example, the file transfer protocol (FTP) could also be used, using "get" and "put" commands in that protocol. Other protocols using messages communicated over TCP/IP connections are also possible. A mix of such protocols may also be used to perform retrieval or storage functions. It is also possible that a service author will keep local copies of document objects of an on-line service so that only a remote storage function is used. Additionally, systems in which a client program modifies and stores documents and programs on the server using protocols over a TCP/IP connection between the client and the server are also within the scope of the invention. The client and server may be connected by the Internet, or a private local or wide area network or may be on the same machine. The client authoring tool may be configured to communicate only with the server. The processing of messages need not be provided by a control script added to the server, but may also be made possible by modifications to the server. These and other embodiments are considered to be within the scope and spirit of the present invention which is defined by the appended claims.

APPENDIX

```
# !/usr/local/bin/tclsh

5  #
  # file put_script
  #
  # This is a put_script for a CERN server that supports the following
  # operations in the Vermeer authoring tool client:
10 #   retrieve - retrieve a document
  #   replace   - replace a previously existing document
  #               (error if it didn't previously exist
  #               or if date/time is later than that passed in)
  #   create    - create a new document
15 #               (error if it previously existed)
  #   parse     - parse a basic document and return tcl
  #   index     - index a document
  #               (indexes should still be recreated regularly).
  #   listservices - return a list of services on the server.
20 #   linkmap   - return a linkmap of documents on the server.
  #
  # This script is triggered by an HTTP PUT method, but HTTP POST method
  # could also be used.

25 #
  # proc DBG 'debug-string'
  #
  #if debugging is enabled (/tmp/debug_put_script exists) then
  #write the debug-string to /tmp/put_script.dbg
30 #
  proc DBG str {
    global dbgon
```

global df

```
if![info exists dbgon] {  
    set dbgon [file exists /tmp/debug_put_script]  
5    if$dbgon {  
        set df [open /tmp/put_script.dbg "w"]  
    }  
}
```

```
10    if$dbgon {  
        puts $df$str  
    }  
}
```

```
15 #  
# proc error 'error-string'  
#  
# Generic error routine for getting a string back to client  
# Note that this terminates the current process  
20 #  
proc error str {  
  
    DBG "error - '$str'"  
    puts stdout "Content-Type: text/html"
```

```
25 <html>  
    <head>  
        <title>Bad Request</title>  
    </head>  
    <body>  
30    <h1>Bad Request</h1>  
    <hr>  
    $str
```

</body>

</html>"

exit 0

5 }

#

proc mktempfile 'File' 'Filename'

#

10 # Create and open for writing a temporary file in \$TMPDIR

#

proc mktempfile { File Filename } {

upvar 1 \$File file

upvar 1 \$Filename filename

15 global tmpdir

global tmpcount

global env

if ![info exists tmpdir] {

20 if [info exists env(TMPDIR)] {

set tmpdir\$env(TMPDIR)

} else {

set tmpdir /tmp

}

25 set tmpcount 0

}

Need a way to ensure exclusive create...

(and maybe put a process id in here...)

30 set filename \$tmpdir/VTtmp\$tmpcount

incr tmpcount

while {[file exists \$filename] == 1} {

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```
    set filename $tmpdir/VTmp$tmpcount
    incr tmpcount
}

5    set file [open $filename w]
    }

    #
    # proc readline 'input line'
10   #
    # Routine for reading a single line from stdin.
    # Reads no more than env(CONTENT_LENGTH) characters
    # (otherwise the process would hang waiting for nonexistent input)
    # Strips trailing CR.
15   # returns -1 if no more input.
    #
    proc readline Line {
        upvar $Line line

20   global contentlength
        global env

        if ![info exists contentlength] {
            if {[info exists env(CONTENT_LENGTH)]} {
25         set contentlength $env(CONTENT_LENGTH)
            } else {
                DBG "no CONTENT_LENGTH environment variable"
                set contentlength 0
            }
30         DBG "contentlength - $contentlength"
        }
    }
```

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```
    if {$contentlength <=0} {  
        return -l  
    }  
  
5    if {[gets stdin line] <0} {  
        return -l  
    }  
  
    # don't fully understand CRLF issues. but for now...  
10    incr contentlength [expr 0- ([string length $line] + 1)]  
    set line [string trimright $line "\r"]  
  
    DBG "input - $line"  
  
15    return 0  
}  
  
#  
# Execution starts here  
20 #  
  
if {[catch {  
  
    DBG "in put_script"  
25  
    #  
    # Make sure we have a document of type "application/x-vermeer"  
    #  
    if ![info exists env(CONTENT_TYPE)] {  
30        error "no content-type\nneed content-type: application/x-vermeer"  
    }  
}
```

```

if {[string tolower$env(CONTENT_TYPE)] != "application/x-vermeer"} {
    error "bad content-type: $env(CONTENT_TYPE)\nneed content-type: application/x-vermeer"
}
#
5 # Read operation headers
# Put them in the associative array 'headers'. indexed by header name
#
while 1 {
    if {[readline line] < 0} {
10         #no more input
        break
    }

    if {0==[string length $line]} {
15         # blank line. end of headers
        break
    }

    set ws "[ \t]*"
20     set alpha "[-A-Za-z]"
    set searchexpr "$ws\($alpha+\)$ws:$ws\(.*\)"
    if [regexp $searchexpr $line foo name value] {
        set headers([string tolower $name]) $value
    } else {
25         error "bad header - \"$line\""
    }
}

#
30 # Compute 'pathroot' and 'molisaroot' for future reference
#
if {[info exists env(PATH_TRANSLATED)]&&[info exists env(PATH_INFO)]} {

```



```
set ix [string last $env(PATH_INFO) $env(PATH_TRANSLATED)]
set pathroot [string range $env(PATH_TRANSLATED) 0 [expr $ix-1] ]
} else {
    error "cannot determine root of document tree "
5  }

set molisaroot [format "%s/Molisa" $pathroot]

#
10 # Most methods require a target url.
    # Get and check it if it exists.
    #

if [info exists headers(url)] {
15     set url $headers(url)
    set fullurl $pathroot$url
    set urlextension [file extension $url]

    if { 0 != [string first "/Molisa" $url] } {
20         error "document is not underneath /Molisa - $url"
    }
} else {
    set url ""
    set fullurl ""
25     set urlextension ""
}

#
# Get the method
30 #

if ![info exists headers(method)] {
    error "no method header"
```

```
    }

    set method $headers(method)

5   DBG "method-$method ""

    #
    # Case off method
    #
10  if { 0 == [string compare $method linkmap] } {
        set result [exec $molisaroot/internal/getliks.tcl $molisaroot/internal/geturl $fullurl]

        puts stdout "Content-Type: application/x-vermeer-linkmap\n"
        puts stdout $result
15    exit 0
    } elseif { 0 == [string compare $method listservices] } {

        # these are the Molisa directories that are _not_ services
        set reserved { internal lib dummyputdir }

20    set rawlist [exec ls $molisaroot]

        set services ""
        foreach f $rawlist {
            if { [file isdirectory $molisaroot/$f]&&
25              (-l == [lsearch -exact $reserved $f]) } {
                lappend services $f
            }
        }

        puts stdout "Content-Type: vermeer/x-vermeer-servicelist\n"
30    foreach f $services {
        puts stdout $f
    }
}
```

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```
puts stdout "ENDOFLLIST "
exit 0
} elseif {0 == [string compare $method index] } {
#
5 # Index
#
DBG "entered index "

set indexer /usr/local/bin/waisindex
10 if ![file exists $fullurl] {
    error "document does not exist - $url"
}

if ![file exists $indexer] {
15     error "indexer does not exist - $indexer"
}
if ![file readable $fullurl] {
    error "document not readable - $url"
}
20
if [file isdirectory $fullurl] {
    DBG "directory index branch"
    set service [file tail $url]
    # We use a Web directory for the html pages. and a parallel wais
25 # directory. rather than mixing wais index files into the Web hierarchy
    set www [file dirname $pathroot]/wais/$service

    catch { exec $indexer - mem 2 -l 1 -export -d $www \
        -t URL $molisaroot/$service http://zorch.tiac.net/Molisa/$service \
30     -r $molisaroot/$service} result
    DBG "result = -$result-"
} else {
```

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```

        DBG "file index branch"
        set below [string range $url 8 end]
        set service [file dirname $below]
# We use a Web directory for the html pages, and a parallel wais
5 # directory, rather than mixing wais index files into the Web hierarchy
        set www [file dirname $pathroot]/wais/$service
        DBG "molisaroot/below = $molisaroot/$below"
        catch { exec Sindexer -mem 2 -l 1 -export -d $www \
            -t URL $molisaroot/$service http://zorch.tiac.net/Molisa/$service \
10         -r $molisaroot/$service } result
        DBG "result = -$result -"
    }

15     puts stdout "Content-Type: text/html

    <html>
    <head>
    <title>Indexing of $url</title>
20 </head>
    <body>
    <h1>Indexing of $url succeeded</h1>
    <pre>"

25     puts -nonewline stdout $result
        puts stdout"

    </pre>
    </body>
    </html>"

30     exit 0
} elseif { 0 == [string compare $method retrieve] } {
#

```

```
# Retrieve
#
    if ![file exists $fullurl] {
        error "document does not exist - $url"
5    }
    if ![file readable $fullurl] {
        error "document not readable - $url"
    }

10  if { 0 == [string compare $urlextension .html] } {
        set contenttype text/html
    } elseif { 0 == [string compare $urlextension .bas] } {
        set contenttype text/x-basic
    } elseif { 0 == [string compare $urlextension .tcl] } {
15        set contenttype text/x-tcl
    } else {
        set contenttype application/binary
    }

20  puts stdout "Content-Type: $contenttype\n"

    set input [open $fullurl r]
    while {[gets $input line] >= 0} {
        puts stdout $line
25    }
    close $input

    exit 0
} elseif {(0 == [string compare $method replace]) ||
30    (0 == [string compare $method create]) } {
    #
    # Replace or create
```

```

#
# May already exist if we're replacing
# Must not exists if we're creating
    if {0 == [string compare $method replace] } {
5   #   if ![file exists $fullurl] {
        #       error "document does not exist - $url"
        #   }
    } else {
        if [file exists $fullurl] {
10         error "document exists - $url"
        }
    }

    if [catch {set output [open $fullurl w] }] {
15         error "document not writable - $url"
    }

# Assume text
set text 1
20 if [info exists headers(content-type)] {
    set contenttype $headers(content-type)
    if ![regexp -nocase "^text/" $contenttype] {
        set text 0
    }
25 }

    DBG "text = '$text'"
    if {$text} {
        while { [readline line] >=0 } {
            puts $output $line
30        }
    } else {
        DBG "about to read '$contentlength' bytes"
    }

```

```
        exec >@ $output $molisaroot/internal/read $contentlength
    }
    close $output

5    # Quick detection of executable files
    # If the directory name is "Scripts" make it executable
    if {0 == [string compare Scripts [file tail [file dirname $fullurl]]]} {
        exec chmod a+x $fullurl
    }

10    puts stdout "Content-Type: text/html"

    <html>
    <head>
15    <title>Create/replace succeeded</title>
    </head>
    <body>
    <h1>Create/replace succeeded </h1>
    </body>
20    </html>"

    exit 0
} elseif {0 == [string compare $method parse]} {
    #
25    # Parse
    #
    mktempfile basicFile baseFileName

    while { [readline line] >=0 } {
30        puts $basicFile $line
    }
    close $basicFile
```

```
mktempfile tclFile tclFileName
```

```
close $tclFile
```

```
set fail [catch {exec $molisaroot/internal/parser <$basicFileName >$tclFileName} result]
```

5

```
if {$fail} {
```

```
    puts stdout "Content-Type: text/html
```

```
<html>
```

10

```
<head>
```

```
<title>Parse failed</title>
```

```
</head>
```

```
<body>
```

```
<h1>Parse failed</h1>
```

15

```
<pre>
```

```
$result
```

```
</pre>
```

```
</body>
```

```
</html>"
```

20

```
    } else {
```

```
        puts stdout "Content-Type: text/html
```

25

```
<html>
```

```
<head>
```

```
<title>Parse succeeded</title>
```

```
</head>
```

```
<body>
```

30

```
<h1>Parse succeeded</h1>
```

```
<pre>"
```



```
        set tclFile [open $tclFileName "r"]
        while {[gets $tclFile line] >=0} {
            puts stdout $line
        }
5      puts stdout "</pre>
</body>
</html>"
    }

10    exec rm $basicFileName $tclFileName
    }

    } vfr_put_result] } {
        DBG "put caught - '$vfr_put_result'"
15    puts stdout "Content-Type: text/html

<HEAD><TITLE>Put Error</TITLE></HEAD><BODY>
<H1>Put Error</H1><pre>$vfr_put_result</pre></body>"
        exit 0
20 }
```

CLAIMS

1. A computer-implemented process for a client to remotely edit a document object stored on a server, wherein the client and the server communicate using an HTTP protocol over a connection, comprising the steps of:

5 establishing a connection between the client and the server.

 the client sending an HTTP request message over the TCP/IP connection to the server, wherein the HTTP request message specifies the document object and an indication that the client requests retrieval of the document object.

 the server receiving the HTTP request message and calling a script.

10 the script retrieving a copy of the document object.

 the server sending the copy of the document object to the client over the TCP/IP connection in an HTTP response message.

 the client receiving the HTTP response message including the copy of the document object.

15 the client permitting editing of the copy of the document object.

 the client sending an HTTP request message to the server, wherein the HTTP request message contains a copy of the edited document object and an indication of a location on the server to store the copy of the edited document object and an indication that the client requests storage of the edited document object.

20 the server receiving the HTTP request message and calling the script.

 the script storing the copy of the edited document object on the server according to the indication of the location included in the HTTP request message, and

 terminating the connection

25 2. The process of claim 1, further comprising the step of the script checking authentication and wherein the step of the script retrieving the copy of the document object includes retrieving the copy only when access to the document object is authenticated.

3. The process of claim 1, further comprising the step of mapping the indication of the
30 location of the document object to a file name on the server.

4. The process of claim 1, further comprising the step of the server responding with an HTTP

response message to the client program, indicating one of acknowledgment that the document was successfully saved and giving an error indication.

5 5. The process of claim 1, wherein the document object is part of an online service on the World Wide Web.

6. 6. The process of claim 1, wherein the document object is comprised of an HTML file.

10 7. The process of claim 1, wherein the document object is a computer program written in a computer programming language.

8. 8. The process of claim 1, wherein the script is a single computer program which processes both retrieve and store requests and is called by the server in response to either a store or a retrieve request from the client.

15 9. The process of claim 1, wherein the HTTP protocol includes a named message method which indicates transfer of arbitrary data from the client to the server and wherein the client sends the server a message including the name of the named message method for both retrieve and store requests.

20 10. The process of claim 9, wherein the named message method is an HTTP "PUT" message.

11. 11. The process of claim 9, wherein the named message method is an HTTP "POST" message.

25 12. The process of claim 1, wherein the server and client are on the same computer.

13. 13. The process of claim 1, wherein the server and the client are on separate computers interconnected by a network.

30 14. The process of claim 13, wherein the network is a local area network.

15. The process of claim 13, wherein the network is Internet.

16. The method of claim 1, wherein the server calls one of multiple scripts.

5 17. The method of claim 1, wherein the connection established is a TCP/IP connection.

18. The method of claim 4, further comprising the step of terminating the TCP/IP connection after the step of the server sending a response message.

10 19. The process of claim 1, wherein the document object is an HTML file including an embedded graphic image.

20. A computer-implemented process for remotely editing an electronic document stored on a server computer, using a client computer, wherein the server computer and the client computer
15 are connected via a communication channel using a communication protocol, and wherein the client computer has an operating system with a first file name space and the server computer has an operating system with a second file name space and no file in the second file name space can be accessed using the name of a file in the first file name space, the process comprising the steps, performed by the client computer, of:

20 sending a request message in the communication protocol and over the communication channel to the server requesting a copy of the electronic document.

receiving a response message in the communication protocol from the server and over the communication channel, wherein the response message contains the copy of the electronic document.

25 permitting editing of the copy of the electronic document at the client computer, and

sending a message in the communication protocol including the edited electronic document over the communication channel and to the server, wherein the message includes an indication of a request that the electronic document be stored on the server computer.

30 21. A computer-implemented process for remotely editing an electronic document stored on a server computer, using a client computer, wherein the server computer and the client computer

are connected via a communication channel using a communication protocol, the process comprising the steps, performed by the client computer, of:

5 sending a request message in the communication protocol and over the communication channel to the server requesting a copy of the electronic document using a name mappable to the file name space of the server and not mappable to the file name space of the client.

receiving a response message in the communication protocol from the server and over the communication channel, wherein the response message contains the copy of the electronic document.

10 permitting editing of the copy of the electronic document at the client computer, and

sending a message in the communication protocol including the edited electronic document over the communication channel and to the server, wherein the message includes an indication of a request that the electronic document be stored on the server computer using a name mappable to the file name space of the server and not mappable to the file name space of the client.

15

22. A client computer system for use in connection with a server computer connected to the client computer via a communication channel using a communication protocol, and wherein the client computer has an operating system with a first file name space and the server computer has an operating system with a second file name space and the first file name space does not include names of files which map to names of files in the second file name space, the client computer system comprising:

means for sending a request message over the communication channel in the communication protocol to the server for a copy of the electronic document.

25 means for receiving a response message in the communication protocol from the server and over the communication channel, wherein the response message contains the copy of the electronic document.

means for permitting editing of the copy of the electronic document at the client computer, and

30 means for sending a message in the communication protocol including the edited electronic document over the communication channel and to the server, wherein the message includes an indication of a request that the electronic document be stored on the server computer.

23. A server computer system for use in connection with a client computer connected to the server computer via a communication channel using a communication protocol, and wherein the client computer has an operating system with a first file name space and the server computer has an operating system with a second file name space and the first file name space does not include names of files which map to names of files in the second file name space. the server computer system comprising:

means for receiving a request message over the communication channel in the communication protocol from the client for a copy of the electronic document.

means for retrieving the copy of the electronic document.

means for sending a response message in the communication protocol to the client and over the communication channel. wherein the response message contains the copy of the electronic document.

means for receiving a message in the communication protocol including an edited electronic document over the communication channel and from the client. wherein the message includes an indication of a request that the electronic document be stored on the server computer. and

means for storing the edited electronic document on the server computer system.

24. A computer-implemented process for editing an electronic document and for use in connection with a client computer connected to a server computer via a communication channel using a communication protocol. and wherein the client computer has an operating system with a first file name space and the server computer has an operating system with a second file name space and the first file name space does not include names of files which map to names of files in the second file name space. the process comprising the steps, performed by the server. of:

receiving a request message over the communication channel in the communication protocol from the client for a copy of the electronic document.

retrieving the copy of the electronic document.

sending a response message in the communication protocol to the client and over the communication channel. wherein the response message contains the copy of the electronic document.

receiving a message in the communication protocol including an edited electronic document over the communication channel and from the client, wherein the message includes an indication of a request that the electronic document be stored on the server computer, and storing the edited electronic document on the server computer system.

5

25. A computer-implemented process for remotely editing an electronic document stored on a server, wherein the client and the server communicate over a communication channel using a communication protocol, and wherein the client computer has an operating system with a first file name space and the server computer has an operating system with a second file name space and the first file name space does not include names of files which map to names of files in the second file name space, comprising the steps of:

10

the client establishing the communication channel with the server,

15

the client sending a message in the communication protocol over the communication channel to the server, wherein the message specifies the electronic document and an indication that the client requests retrieval of the electronic document.

the server receiving the message and checking authentication,

the server retrieving a copy of the electronic document if access is authenticated,

the server sending the copy of the electronic document to the client over the communication channel in a message in the communication protocol,

20

the client receiving the message from the server including the copy of the electronic document.

the client permitting editing of the copy of the electronic document.

25

the client sending a message over the communication channel and in the communication protocol to the server, wherein the message contains a copy of the edited document and an indication of a location on the server to store the copy of the edited document and an indication that the client requests storage of the edited document.

the server receiving the message and storing the copy of the edited document on the server at the location specified in the message, and

30

the server sending a message acknowledging an attempt at storage of the edited document.

26. A computer system for remotely editing an electronic document, comprising:

a client computer and a server computer interconnected by a communication channel using a communication protocol, and wherein the client computer has an operating system with a first file name space and the server computer has an operating system with a second file name space and the first file name space does not include names of files which map to names of files in the second file name space.

wherein the client computer includes:

means for sending a request message over the communication channel in the communication protocol to the server for a copy of the electronic document.

means for receiving a response message in the communication protocol from the server and over the communication channel, wherein the response message contains the copy of the electronic document.

means for permitting editing of the copy of the electronic document at the client computer, and

means for sending a message in the communication protocol including the edited electronic document over the communication channel and to the server, wherein the message includes an indication of a request that the electronic document be stored on the server computer, and

wherein the server computer includes:

means for receiving a request message over the communication channel in the communication protocol from the client for a copy of the electronic document.

means for retrieving the copy of the electronic document.

means for sending a response message in the communication protocol to the client and over the communication channel, wherein the response message contains the copy of the electronic document.

means for receiving a message in the communication protocol including an edited electronic document over the communication channel and from the client, wherein the message includes an indication of a request that the electronic document be stored on the server computer, and,

means for storing the edited electronic document on the server computer system.

30

27. A process for handling a request message from a remote editor, comprising the steps of:
determining whether the request message is from a client authoring tool.

determining whether the request message is for retrieval of a document object when the request message is from the authoring tool.

sending a response message to the authoring tool including the document object when the request message is for retrieval.

5 determining whether the request message is for storage of a document object when the request message is from the authoring tool.

storing the document object when the request message is for storage, and

sending a response message to the authoring tool acknowledging storage of the document object when the request message is for storage.

10

28. A process for saving a document object on a remote server, and wherein the client computer has an operating system with a first file name space and the server computer has an operating system with a second file name space and the first file name space does not include names of files which map to names of files in the second file name space, comprising the steps
15 of:

sending a request message to the remote server, wherein the request message includes the document object, an indication of a location on the remote server and an indication that the document object is to be stored on the remote server.

the remote server receiving the request message and converting the indication of the
20 location into a file name, and storing the document object as a file using the file name, and
the remote server sending a response message acknowledging storage of the document object.

29. A client computer for use in a client/server computer system for remotely editing
25 document objects stored on the server computer, the client computer comprising:

an editing system having inputs connected to receive editing commands, a memory for storing the document object while it is edited in response to the editing commands and an output for displaying the document object to the user during editing,

a retrieve request message processor having an input connected to receive an indication
30 of a document object on the server to be retrieved and an output providing a retrieve request message, including an indication of the document object, to a communication channel connected to the server computer:

a response message processor having an input connected to receive a response message from the server and operative when the retrieve request message section sends a retrieve request message to the server, wherein the response message includes the document object, and an output providing the document object to the memory of the editing system, and

5 a store request message processor, connected to access the memory of the editing system, and having an input connected to receive an indication of the location on the server for storing the document object and an output providing a store request message including the edited document object and an indication of a location on the server where the document object is to be stored, wherein the output connects to the communication channel connected to the server.

10 30. A server computer for use in a client/server computer system in which a client computer remotely edits document objects stored on the server computer, the server computer comprising:
memory in which document objects are stored.

15 a retrieve request message processor having an input connected to receive retrieve request messages from the client computer, wherein a retrieve request message includes an indication of a document object stored on the server, wherein the retrieve request message processor accesses the memory to retrieve the document object indicated in the retrieve request message, and having an output providing a response message including the retrieved document object to the client computer, and

20 a store request message processor having an input connected to receive store request messages from the client computer, wherein a store request message includes a document object and an indication of a location on the server for storing the document object, and which stores the document object in a location corresponding to the indication in the store request message.

25 31. A process for remotely, storing a document from a client to a server, comprising the steps of:

establishing a TCP/IP connection between the client and the server.

the client sending a request message over the TCP/IP connection to the server, the request message including the document to be stored and an indication of a location on the server in

30 which the document is to be stored.

the server receiving the request message and storing the document in a location corresponding to the indication in the request message.

32. A computer-implemented process for enabling a client computer to store a document object on a server computer, comprising the steps, performed by the server computer, of:

receiving an HTTP request message from the client computer over a TCP/IP connection, wherein the HTTP request message has content including a copy of the document object and an indication of a location on the server computer to store the copy of the document object and an indication that the client computer requests storage of the document object; and

executing a process using the content of the HTTP request message to store the copy of the document object on the server computer according to the indication of the location included in the HTTP request message.

33. In a computer system for enabling a client computer to store a document object on a server computer, the server computer comprising:

means for receiving an HTTP request message from the client computer over a TCP/IP connection, wherein the HTTP request message has content including a copy of the document object and an indication of a location on the server computer to store the copy of the document object and an indication that the client computer requests storage of the document object; and

means for executing a process using the content of the HTTP request message to store the copy of the document object on the server computer according to the indication of the location included in the HTTP request message.

34. In a computer system for enabling a client computer to store a document object on a server computer, the server computer comprising:

a computer-readable and writable storage medium;

a TCP/IP mechanism, having an input for receiving a request from the client computer to establish a TCP/IP connection with the client computer and which establishes the TCP/IP connection; and

an HTTP server having an input for receiving an HTTP request message from the client computer over the TCP/IP connection via the TCP/IP mechanism, wherein the HTTP request message has content including a copy of the document object and an indication of name used by the HTTP server to retrieve the document object as stored on the storage medium and an indication that the client computer requests storage of the document object, and an output for storing the copy of the document object from the HTTP request message on the computer-

readable and writable storage medium as a file according to the name included in the HTTP request message.

35. A computer-implemented process for enabling a client computer to store a document object on a server computer, comprising the steps, performed by the client computer, of:
- 5 establishing a TCP/IP connection with the server computer;
 - sending an HTTP request message to the server computer over the TCP/IP connection, wherein the HTTP request message has content including a copy of the document object and an indication of a location on the server computer to store the copy of the document object and an
 - 10 indication that the client computer requests storage of the document object; and
 - receiving an HTTP response message from the server computer indicating a result of an attempt by the server computer to store the copy of the document object.

36. A computer-implemented process for enabling a client computer to store a document object on a server computer, the process comprising the steps, performed by the server computer, of:

receiving a request message from the client computer, wherein the request message has content including a copy of the document object, an indication of a location on the server computer, defining an indicated name which is a universal name used by other clients to access

20 the document object on the server computer, and an indication that the document object is to be stored in the indicated location on the server computer:

converting the indicated name into a file name in a file name space of the server computer and storing the document object as a file on the server computer using the file name in the file name space of the server computer: and

25 sending a response message to the client computer acknowledging storage of the document object.

37. In a computer system for enabling a client computer to store a document object on a server computer, the server computer comprising:
- 30 means for receiving a request message from the client computer, wherein the request message has content including a copy of the document object, an indication of a location on the server computer, defining an indicated name which a universal name to be used by other clients

to retrieve the document object, and an indication that the document object is to be stored in the indicated location on the server computer;

means for converting the indicated name into a file name in a file name space of the server computer and storing the document object as a file on the server computer using the file name in the file name space of the server computer; and

means for sending a response message to the client computer acknowledging storage of the document object.

38. In a computer system for enabling a client computer to store a document object on a server computer, the server computer comprising:

a computer-readable and writable storage medium;

a server program executed on the server computer having:

a. an input connected to receive a request message from the client computer, wherein the request message has content including a copy of the document object, an indication of a name to be used by the server program to retrieve the document object which is a universal name used by other clients to retrieve the document object, and an indication that the document object is to be stored on the computer-readable and writable storage medium;

b. a first output for providing a file name in a file name space of the server computer converted from the indicated name in the received message and a command to the server computer to store the document object as a file on the computer-readable and writable storage medium using the file name in the file name space of the server computer; and

c. a second output connected to the client computer to provide a response message to the client computer acknowledging storage of the document object.

39. A computer-implemented process for enabling a client computer to store a document object on a server computer, comprising the steps, performed by the server computer, of:

receiving a request message from the client computer, wherein the request message has content including a copy of the document object, an indication of an application sending the message, an indication of a location on the server computer, and an indication that the document object is to be stored in the location on the server computer;

determining whether the request message is from an authorized source by comparing the indication of the application in the content of the request message with accepted applications;

when the request message is from an authorized source, storing the document object on the server computer using the location indicated in the request message and sending a response message to the client computer acknowledging storage of the document object; and

5 when the request message is not from an authorized source, sending a response message to the client computer without storing the document object on the server computer.

40. In a computer system for enabling a client computer to store a document object on a server computer, the server computer comprising:

means for receiving a request message from the client computer, wherein the request
10 message has content including a copy of the document object, an indication of an application sending the message, an indication of a location on the server computer, and an indication that the document object is to be stored in the location on the server computer:

means for determining whether the request message is from an authorized source by
comparing the indication of the application in the content of the request message with accepted
15 applications:

means, operative when the request message is from an authorized source, for storing the document object on the server computer using the location indicated in the request message and sending a response message to the client computer acknowledging storage of the document
object; and

20 means, operative when the request message is not from an authorized source, for sending a response message to the client computer without storing the document object on the server computer.

41. In a computer system for enabling a client computer to store a document object on a
25 server computer, the server computer comprising:

a computer-readable and writable storage medium:

a server program executed by the server computer having:

a. an input for receiving a request message from the client computer, wherein the request message has content including a copy of the document object, an indication of an
30 application sending the message, an indication of a location on the server computer, and an indication that the document object is to be stored in the location on the server computer:

b. a comparator having a first input for receiving the indication of the application and a second input for receiving an indication of an authorized source and an output providing an indication of whether the request message is from an authorized source;

c. a first output which provides a command to the server computer when the request
5 message is from an authorized source to store the document object on the computer readable and writable storage medium as a file using the name indicated in the request message; and

d. a second output which provides a response message to the client computer
acknowledging storage of the document object when the request message is from an authorized
source and, when the request message is not from an authorized source, which provides a
10 response message to the client computer not acknowledging storage of the document object.

42. A computer-implemented process for enabling a client computer to edit a document
object stored on a server computer, comprising the steps of:

transmitting a first HTTP request message from the client computer over a TCP/IP
15 connection to the server computer, wherein the first HTTP request message specifies the
document object and an indication that the client computer requests retrieval of the document
object from the server computer:

executing a process on the server computer using the first HTTP request message which
retrieves a copy of the document object:

20 transmitting the copy of the document object from the server computer to the client
computer over a TCP/IP connection in a first HTTP response message:

editing the document object on the client computer:

transmitting a second HTTP request message from the client computer over a TCP/IP
connection to the server computer, wherein the second HTTP request message contains a copy of
25 the document object and an indication of a location on the server computer to store the copy of
the document object and an indication that the client computer requests storage of the document
object:

executing a process on the server computer using the second HTTP request message
which stores the copy of the document object on the server computer according to the indication
30 of the location included in the second HTTP request message.

43. A computer system for editing of document objects, comprising:

a server computer and a client computer.

wherein the client computer, comprises:

means for sending a first HTTP request message over a TCP/IP connection to the server computer, wherein the first HTTP request message specifies the document object and an indication that the client computer requests retrieval of the document object from the server computer:

means for receiving an HTTP response message from the server including the copy of the requested document object;

means for editing the document object on the client computer: and

means for sending a second HTTP request message over a TCP/IP connection to the server computer, wherein the second HTTP request message contains a copy of the edited document object and an indication of a location on the server computer to store the copy of the document object and an indication that the client computer requests storage of the document object: and

wherein the server computer comprises:

means for executing a process on the server computer using the first HTTP request message which retrieves a copy of the document object: and

means for transmitting the copy of the document object from the server computer to the client computer over a TCP/IP connection in the HTTP response message: and

means for executing a process on the server computer using the second HTTP request message which stores the copy of the document object on the server computer according to the indication of the location included in the second HTTP request message.

44. A computer-implemented process for enabling a client computer to edit a document object on a server computer, the process comprising the steps of:

sending a read request message from the client computer to the server computer, wherein the read request message specifies the document object using an indication of a location on the server, defining an indicated name which is a universal name used by other clients to retrieve the document object, and an indication that the client computer requests retrieval of the document object:

converting, on the server computer, the indication of the document object to a file name in a file name space of the server computer and retrieving a copy of the document object from the server computer using the file name;

5 sending the copy of the document object from the server computer to the client computer in a read response message;

editing the copy of the document object on the client computer:

10 sending a write request message from the client computer to the server computer, wherein the write request message includes a copy of the document object, a universal name for the document object to be used by other clients to access the document object, and an indication that the document object is to be stored on the server computer to be accessible by the client computer using the universal name in the message;

converting on the server computer the indicated name into a file name in the file name space of the server computer and storing the document object as a file using the file name in the file name space; and

15 sending a write response message to the client computer acknowledging storage of the document object.

45. A client application for use on a client computer for editing a document object stored on a remote server computer, comprising, with an integrated user interface providing access to
20 simultaneously to:

a. means for retrieving the document object from the server computer, including
i) means for sending a read request message to the server computer including
an indication of the document object using a universal name to be used by other
clients to access the document object, and an indication that a copy of the document
25 object is to be sent by the server computer to the client computer.

ii) means for receiving a read response message from the server computer
including the copy of the document object, and

iii) storing the copy of the document object in memory.

b. means for editing the document object stored in the memory;

30 c. means for storing the edited document object on the server computer.
including

i) means for sending a write request message to the server including the copy of the edited document object from the buffer and an indication of a universal name to be used by other clients to access the document object on the server to store the edited document object. and

5 ii) means for receiving an acknowledgment message from the server computer and for communicating the acknowledgment message to a user. and

d. means allowing a user to activate any of the means for retrieving, editing or storing with an integrated user interface.

10 46. A computer-implemented process for enabling a client computer to edit a document object on a server computer, comprising the steps of:

transmitting a read request message from the client computer to the server computer, wherein the request message includes an indication of the document object, an indication of an application sending the message, and an indication that the document object is to be sent to the

15 client computer:

determining on the server computer whether the read request message is from an authorized source by comparing the indication of the application in the content of the request message with accepted applications:

when the read request message is from an authorized source, retrieving a copy of the document object on the server computer and sending a first response message to the client computer including the copy of the document object: and

when the read request message is not from an authorized source, sending a response message to the client computer without sending a copy of the document object:

editing the copy of the document object on the client computer:

25 transmitting a write request message from the client computer to the server computer, wherein the write request message includes a copy of the document object edited by the client computer, an indication of a location on the server computer, an indication of an application sending the message, and an indication that the document object is to be stored in the location on the server computer:

30 determining, on the server computer, whether the write request message is from an authorized source by comparing the indication of the application in the content of the request message with accepted applications:

when the write request message is from an authorized source, storing the document object on the server computer as a file using the location indicated in the write request message and sending an acceptance response message acknowledging storage of the document object; and

when the write request message is not from an authorized source, sending a denial response
5 message to the client computer without storing the document object on the server computer.

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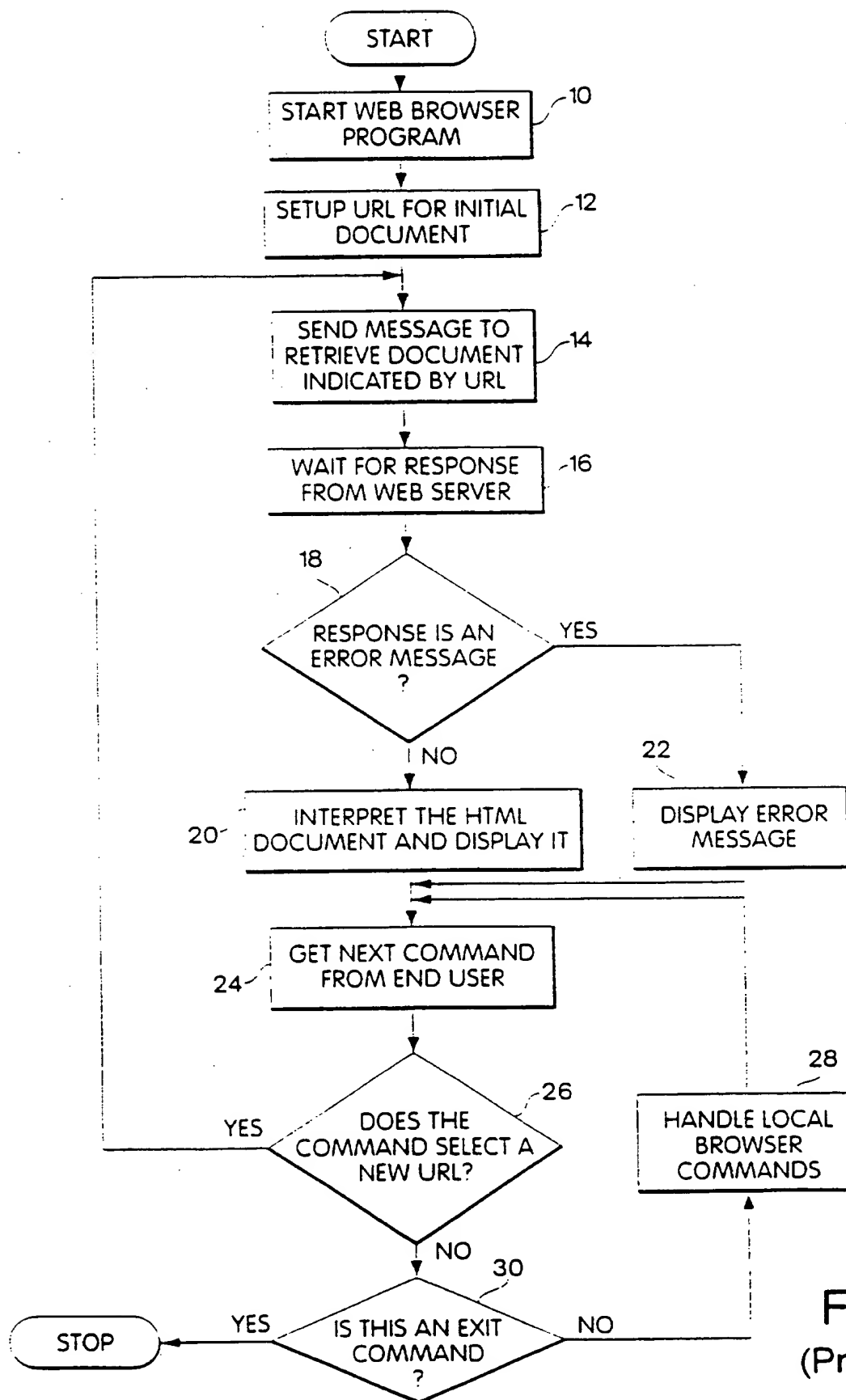


Fig. 1
(Prior Art)

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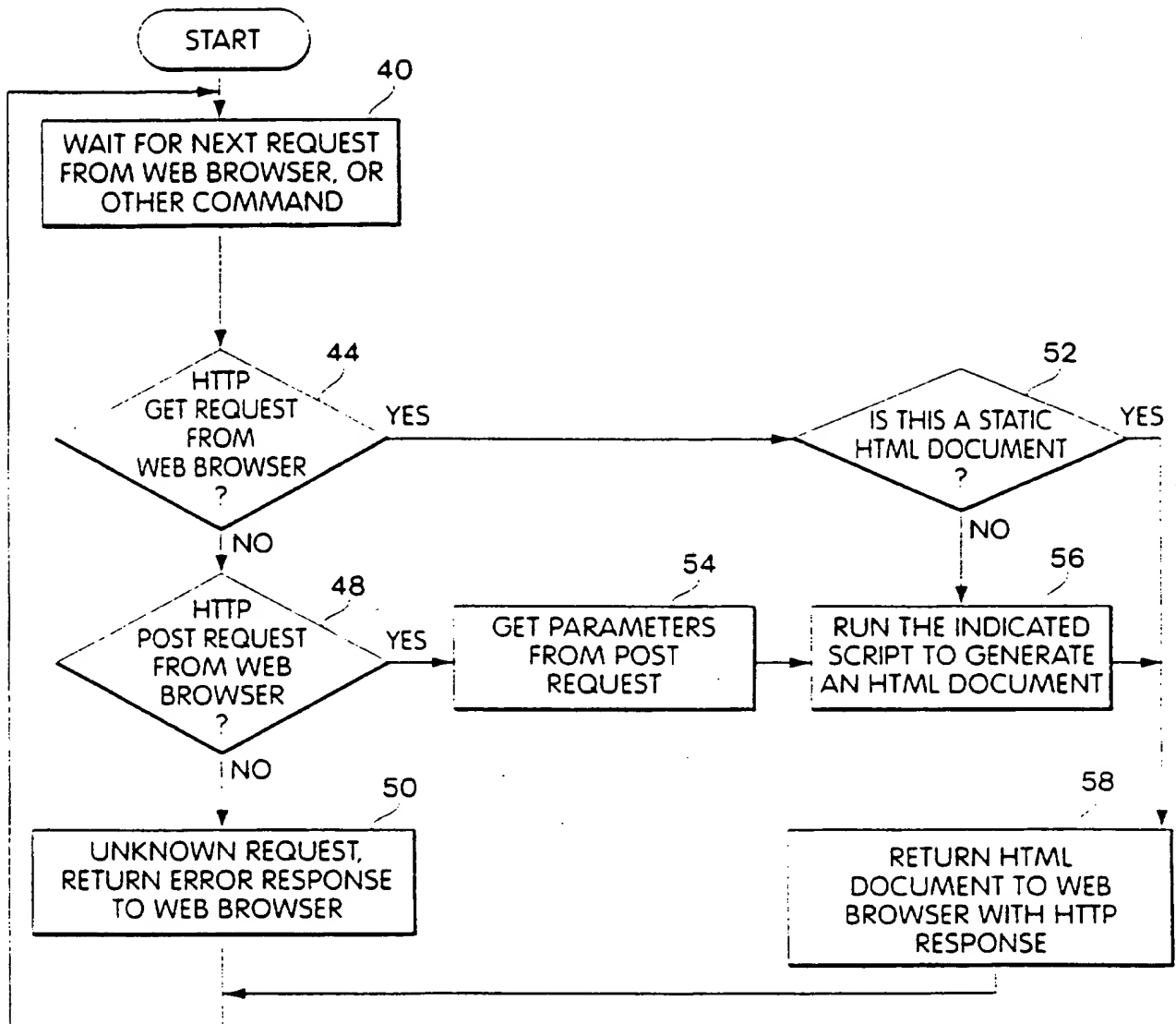


Fig. 2
(Prior Art)

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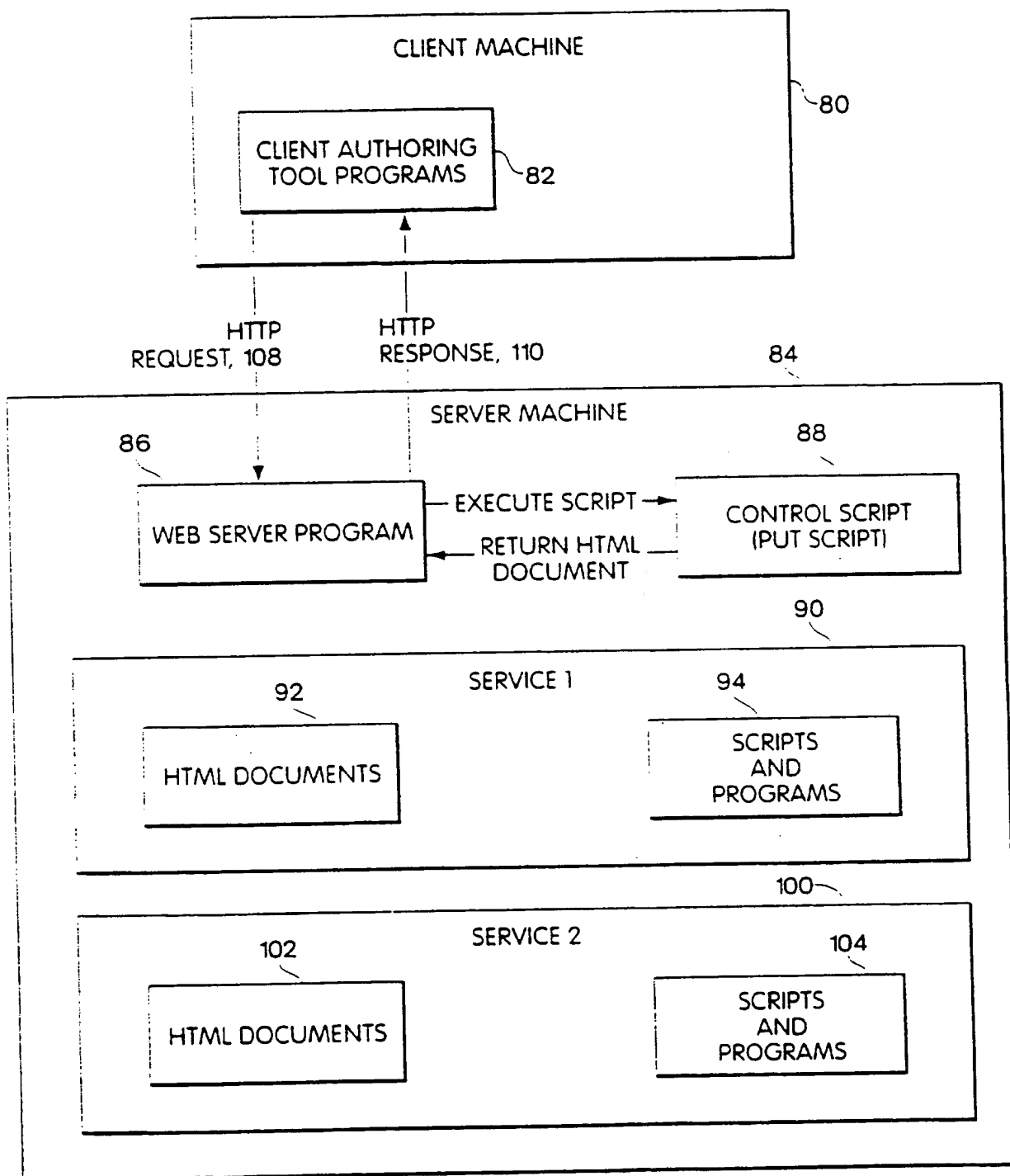


Fig. 3

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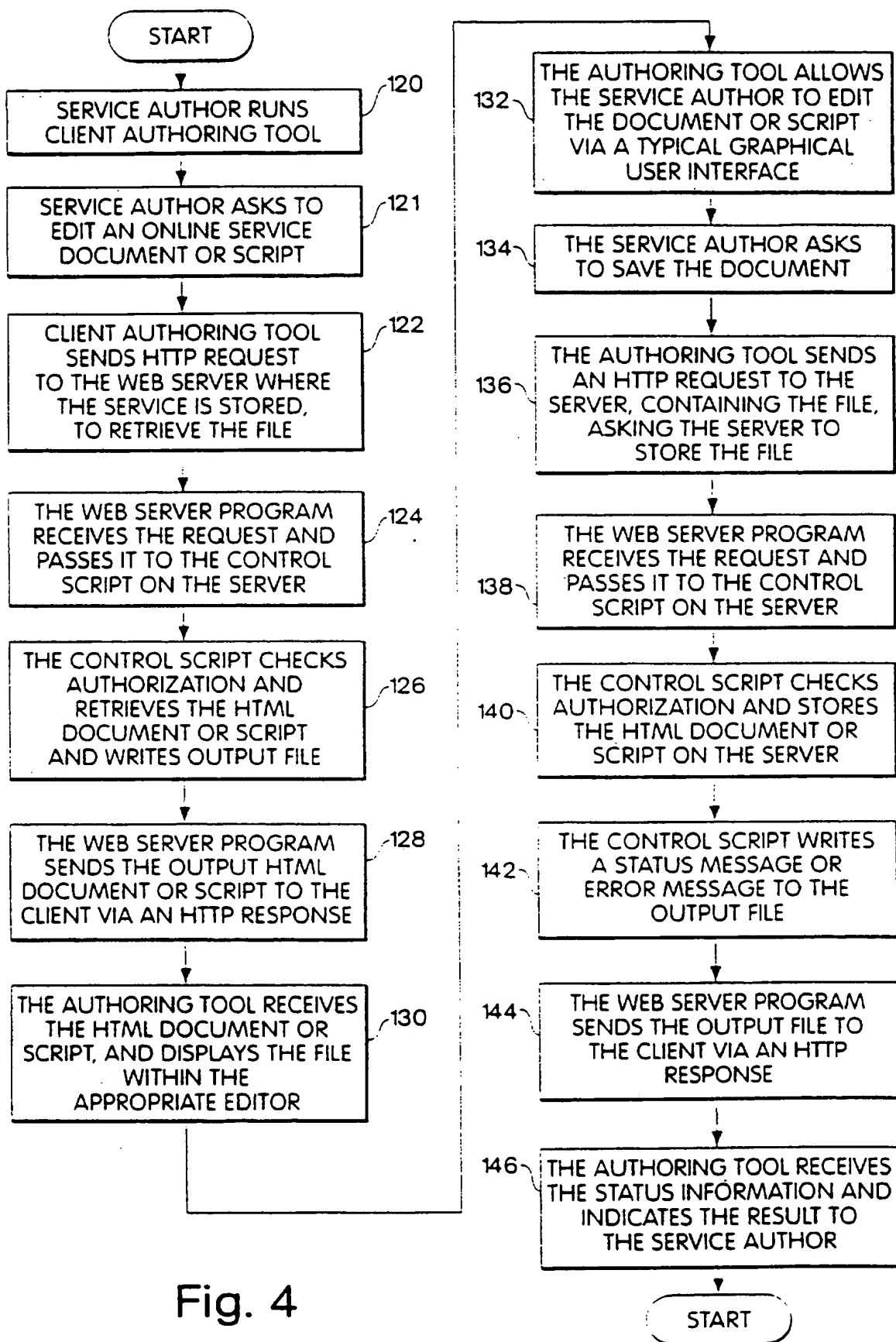


Fig. 4

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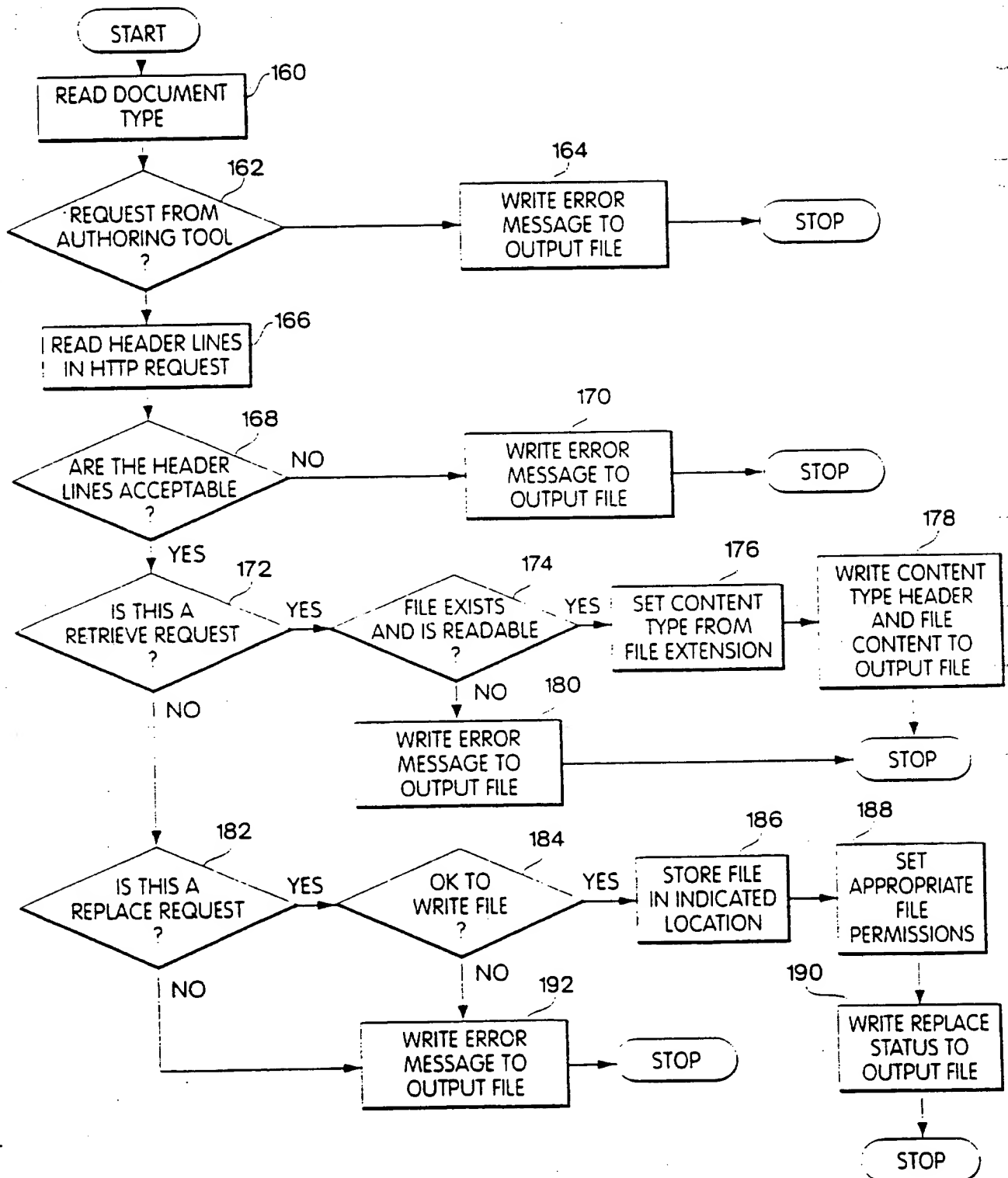


Fig. 5

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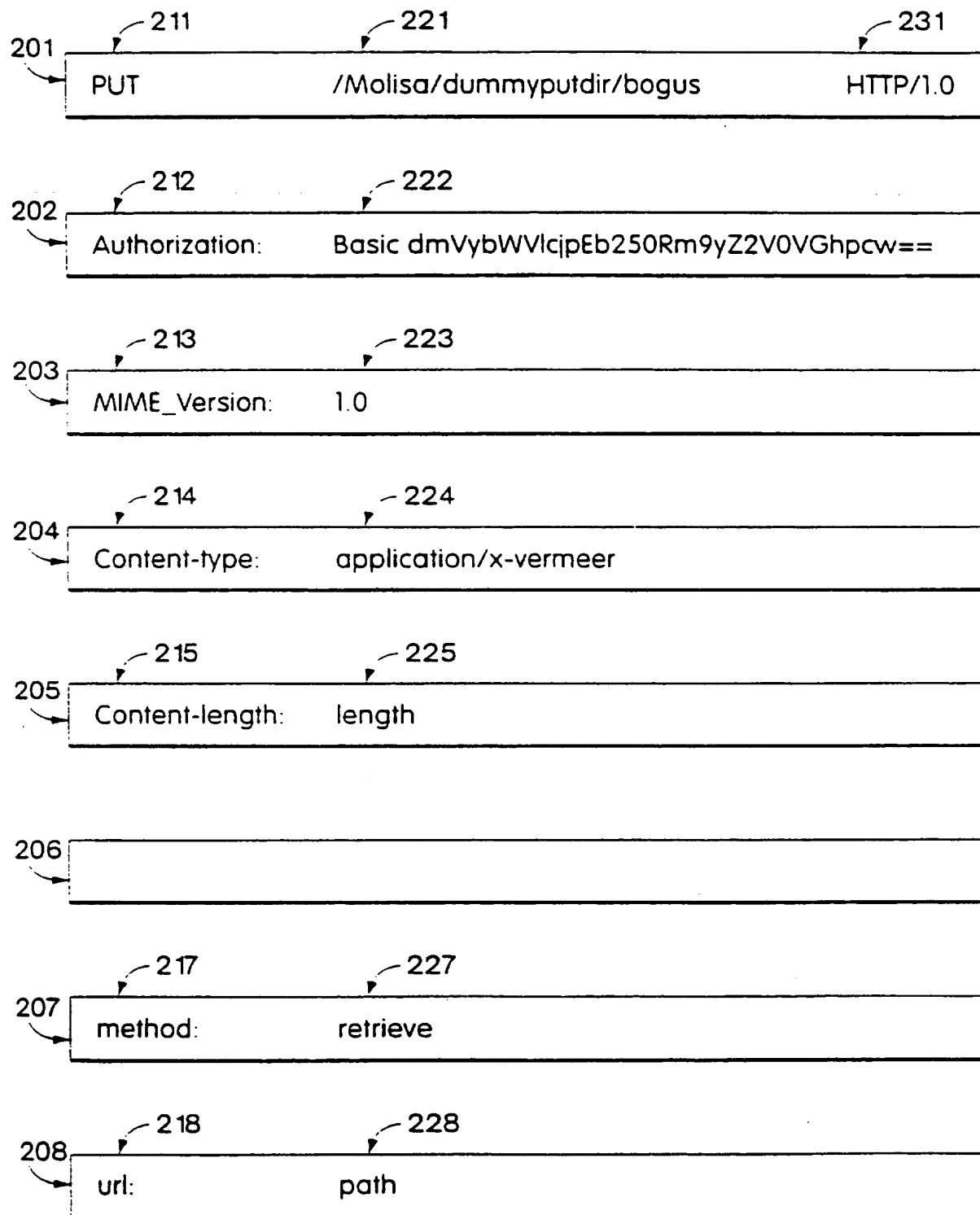


Fig. 6A

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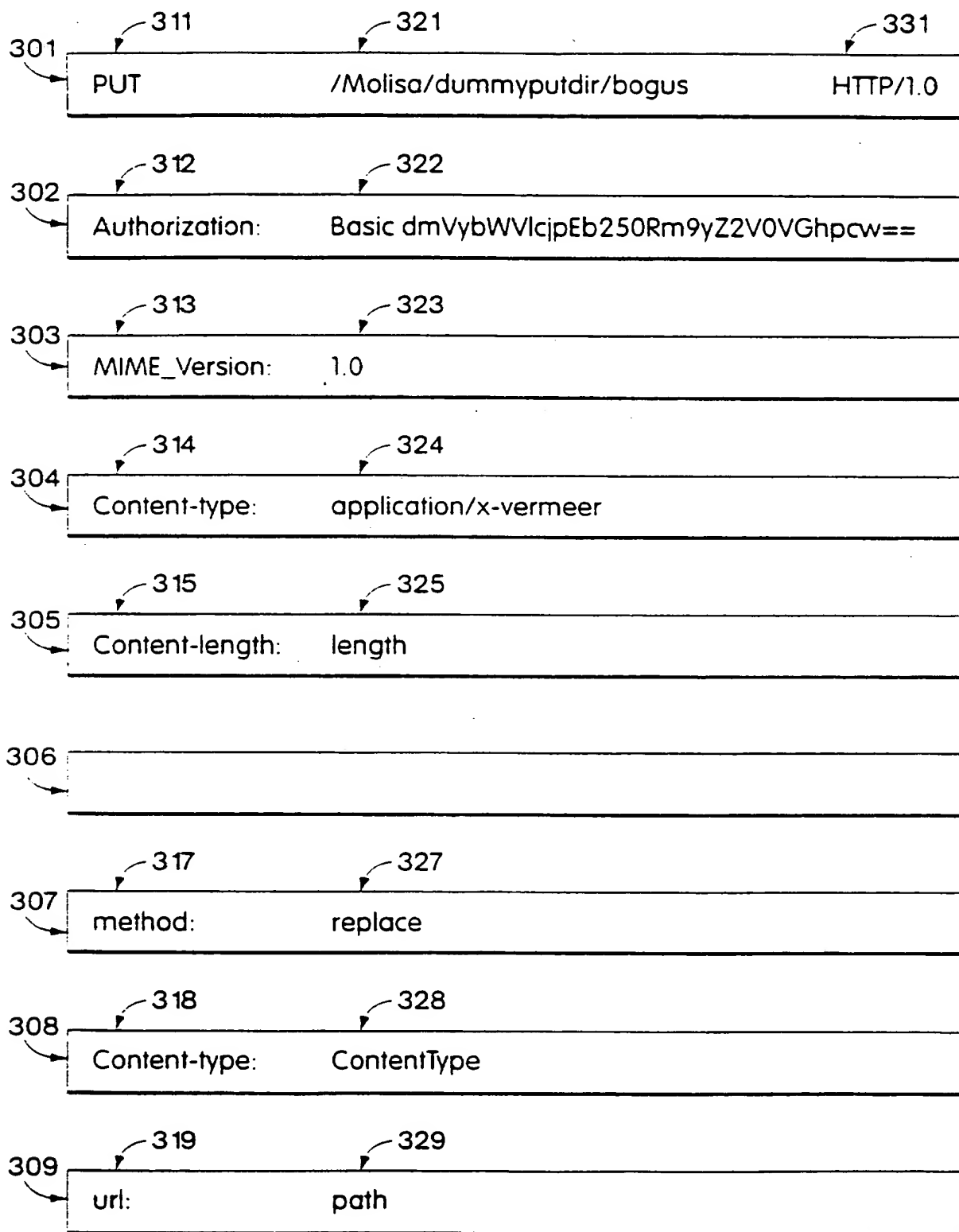


Fig. 6B

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/US 96/03650

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06F17/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	<p>THIRD INTERNATIONAL WORLD-WIDE WEB CONFERENCE, DARMSTADT, GERMANY, 10-14 APRIL 1995, vol. 27, no. 6, ISSN 0169-7552, COMPUTER NETWORKS AND ISDN SYSTEMS, APRIL 1995, NETHERLANDS, pages 841-847, XP000565183 PAOLI J: "Cooperative work on the network: edit the WWW!" see the whole document</p> <p style="text-align: center;">---</p> <p style="text-align: center;">-/-</p>	1-46

☒ Further documents are listed in the continuation of box C.

☐ Patent family members are listed in annex.

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- * A* document defining the general state of the art which is not considered to be of particular relevance
- * E* earlier document but published on or after the international filing date
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Date of the actual completion of the international search

10 July 1996

Date of mailing of the international search report

25.07.96

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Katerbau, R

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 96/03650

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	<p>THIRD INTERNATIONAL WORLD-WIDE WEB CONFERENCE, DARMSTADT, GERMANY, 10-14 APRIL 1995, vol. 27, no. 6, ISSN 0169-7552, COMPUTER NETWORKS AND ISDN SYSTEMS, APRIL 1995, NETHERLANDS, pages 831-840, XP000573398 QUINT V ET AL: "A structured authoring environment for the World-Wide Web" see the whole document</p> <p>---</p>	1-46
A	<p>COMPUTER NETWORKS AND ISDN SYSTEMS, NOV. 1994, NETHERLANDS, vol. 27, no. 2, ISSN 0169-7552, pages 289-295, XP000573397 SLATER A F: "Controlled by the Web" see the whole document</p> <p>-----</p>	1-46

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